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A NEW GENUS OF SCARABAEIDAE WITH DESCRIPTIONS AND NOTES ON PHYLLOPHAGA*

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This paper includes an interesting new genus of Scarabaeidae from Texas, a new Phyllophaga from Texas, and two new Phyllophaga from Alabama. The new Alabama species now bring the total Phyllophaga for the state to 60 species and varieties. In addition to the new descriptions in this paper, notes are given on other little known species of Phyllophaga.

Benedictia new genus

Antennae 10-segmented, the insertion visible from above. Posterior margin of clypeus sharply declivous, the front margin with two long triangular perpendicular projections. Mandibles not visible from above. Labrum free, transverse, highly sclerotized. Pronotum glabrous, except at extreme posterior margin, margined and with the front margin, especially at middle, membranous. Elytra glabrous, strongly narrowed behind. Pygidium free, without spiracle. Abdominal sternites seven, free, and most of them nearly equal. Penultimate dorsal and ventral abdominal segments not connate. Abdominal spiracles slightly divergent, located on ventral abdominal segments and near lateral membranes. Prosternum produced anteriorly and carinate before the front coxae. Front coxae conico-transverse. Front tibia 3-toothed and with an internal movable spur. Claws of all tarsi equal, 3-toothed. Hind and middle tibiae with two free spurs. Entire venter clothed with long whitish hairs.

Genotype: **Benedictia pilosa** n. sp.

This genus apparently should be referred to the Pleocominae by a number of characters, but appears to

* Research Paper No. 626 Journal Series, University of Arkansas.

be quite distinct from either of the genera of the United States included therein. The possession of ten segments in the antennae, the peculiar type of claws, and other characters would seem to exclude it from *Pleocoma* or *Acoma*. Superficially this beetle resembles some of our species of *Amphicoma* but among other things differs in the absence of a spiracle in the pygidium. If the abdomen is examined on the side in the male (female unknown), seven segments are clearly evident.

The genus is named after Mr. Warwick Benedict, Coleopterist at the University of Kansas. To Mr. Benedict, I am grateful for introducing me to the study of Coleoptera, and for his many kindnesses while we were working with the Snow Collection of beetles.

***Benedictia pilosa* n. sp**

Length, 13-15 mm.; width 5.5-6 mm.

Body oblong-elongate, but very slightly depressed, deep reddish-brown above. Club of antenna 2 mm. in length, normally 5-segmented (but 4-segmented in the remaining club in type), longer than stem. Basal antennal segment rather suddenly swelling from base. Second segment narrower than first, slightly wider than long. Third narrower than second, the width and length subequal. Fourth slightly wider than long. Fifth prolonged into a short process. Sixth forming the first major lamella of club, and but slightly shorter than the seventh to the tenth which are equal. Apex of club slightly curved. Front between the eyes slightly convex and limited on the inside of each canthus by a prominent curved carina. Clypeus flat, transverse, nearly perpendicular to body and sharply declivous posteriorly. Two large conspicuous depressed areas behind the declivity. An inconspicuous raised, longitudinal ridge between the depressions. Depressions glabrous, moderately and irregularly punctured. Posterior margin of clypeus slightly produced. Sides in basal one-third nearly parallel, thence convergent anteriorly. Apex with two large perpendicular projections, each as long as its width at base and nearly separated from the other by its width at base. Surface of clypeus irregularly punctured. Pronotum transverse, about two-fifths wider than long. Widest at middle, convergent posteriorly, posterior angles broadly rounded. Margin of pronotum entire; anterior margin membranous at middle. Lateral margins with ir-

regular, long, coarse hairs. Posterior margin with a very conspicuous row of short, dense, white hairs. Disc rather irregularly and closely punctured in anterior half. the punctures here larger and occupying all of sides of pronotum to posterior rounded angles. Disc from about middle to base more finely punctured. Elytra widest at base, wider than pronotum, and rather suddenly narrowed behind the basal third leaving lateral margins of abdominal segments visible. Lateral margin conspicuous to a point some distance before apex. Elytral apices nearly separately rounded. Sutural costa distinct. Two or three discal costae faintly evident. Disc very finely, sparsely and irregularly punctured. Maxillary palpus 4-segmented, the terminal segment nearly four times longer than wide and approximately equal to the three preceding combined. Mentum elongate-oval. Fore tibia tridentate, the apical tooth longer than the two basal ones. First anterior tarsal segment equal in length to next three combined. Fifth segment nearly equal to length of first one. Claws on all tarsi equal, each with a small rounded basal swelling and three long straight, nearly equal teeth. Prosternum between the front coxae with a prominent hirsute process. Entire venter clothed with long, dense, whitish hairs, these hairs extending upon the sides of abdominal segments visible from above, also prominent between the elytral and pronotal bases. Hind femur about twice as long as wide, the tibia at apex nearly one-half as wide as its length. Seven visible abdominal segments in the male when examined from the side, the last retracted within the penultimate one. Pygidium about as long as wide, distinctly narrowed posteriorly. Pygidium also clothed with long, whitish hairs. For figures of the male genitalia, see Plate I, figures 11 and 12.

Holotype male, Presidio Co., Tex., July 16, 1927, R. H. Beamer; paratype males as follows: Presidio, Tex., Sept. 14, 1935, 1; Presidio, Tex., Sept. 2, 1938, and June 14, 1930, W. L. Owen, Jr., 2; Big Bend Park, Brewster Co., Tex., Sept. 5, 1937, Rollin H. Baker, 2. Holotype in the Francis Huntington Snow Collection, University of Kansas, one of the Brewster Co. paratypes in my collection, the other in the collection of O. L. Cartwright, Clemson College, South Carolina, and the three Presidio paratypes in the collection of Mr. Lawrence W. Saylor,

Washington, D. C. I am grateful to Mr. Cartwright for allowing me to retain one of his two specimens.

***Phyllophaga lodingi* n. sp.**

Length, 18.5-23 mm.; width 9.5-11.5 mm.

This species belongs to the **fusca-rugosa** Group of Horn (Revision of the Species of *Lachnosterna* of America North of Mexico, Trans. Amer. Ent. Soc., XIV, 1887).

Form oblong, distinctly wider behind. Color from light brown to deep black. Dorsal surface shining, glabrous.

Antennae 10-segmented, the club fully equal to segments one to seven combined. Maxillary palpi distinctly impressed. Clypeus rather deeply emarginate with margin very slightly reflexed; surface flat, densely and confluent punctured. Front more coarsely punctured than clypeus but with distinct interspaces; clypeal suture distinctly impressed.

Pronotum very unevenly punctured, the punctures moderate and separated from one to many times their diameters. Punctures along base of pronotum between posterior angle and median lobe finer and confluent. A few of the punctures along the sides with minute hairs. Sides of pronotum at base parallel then slightly rounded at middle and straight to apex.

Elytra very finely and irregularly punctured. Sutural costa distinct from a point behind scutellum to apex; discal costa distinct, the one nearest the sutural costa considerably widened behind.

Pygidium convex, distinctly wider than long, finely and nearly regularly punctured; shining.

Abdomen very finely punctured and with a short hair arising from each puncture; the punctures more sparse toward the middle. Abdomen flattened at middle; penultimate segment with an oblique elevation on either side of middle and with the posterior two-thirds of segment depressed. Segment finely granulate in depression. Last abdominal segment broadly and shallowly excavated and nearly smooth at middle, rather coarsely punctured on each side of depression.

Fixed spur of hind tibia short, broad at base, and about one-half the length of free spur. The free spur

slightly shorter than first tarsal segment and distinctly widened at middle. Tooth of claw strong and median.

Metasternum rather finely punctured with a fine hair arising from each puncture.

Holotype male, Smither's Mountain, Madison Co., Ala., June, 1937. Allotype female, same data as holotype. Paratypes as follows: one female, same data as types; Monte Sano, Ala., VI-18-37, H. P. Loding, 2 males, 1 female; same locality, XI-32, 1 female; VII-1932, 4 males; June, 7 males, 3 females; Jackson, Ala., VI-21-1931, 2 males, 2 females; Tuscaloosa Co., Ala., VI-20-1933, 1 female; 1 male from Alabama but without definite locality.

The female has the club of antenna about equal to segments 2-7 combined. Abdomen very convex and extremely finely punctured at middle. Last abdominal segment unmodified.

This species shows a certain resemblance to **bipartita** (Horn) and **forsteri** (Burm.) but is easily separated by the characters of the male and female genitalia.

The species is named after Mr. H. P. Loding, the foremost authority on Alabama Coleoptera. He has allowed me to retain the types and some of the paratypes. Other paratypes have been returned to his collection.

For figures of the male and female genitalia, see Plate I, figures 7 to 10.

Phyllophaga jonesi n. sp.

Length, 21-22 mm.; width, 10.5 mm.

The present species possesses the general oblong shape of **ilicis** (Knoch) and is otherwise closely related to that species.

Body widest at middle of elytra. Color deep reddish-brown, distinctly pruinose and iridescent above. Color of head black, rather sharply contrasting with that of pronotum and elytra.

Antennae 10-segmented, the club nearly as long as the first seven segments; color reddish-brown, the club a little lighter than color of legs. Clypeus distinctly emarginate, very closely and occasionally confluent punctured. Front a little less closely punctured only near clypeal suture. A very tiny erect hair arising from each puncture on front.

Pronotum very closely and especially confluent punctured on sides, the punctures all transverse. A slender recumbent hair arising from each puncture. Sides of pronotum only with a few larger and stiffer hairs arising along the finely crenated margins. A smooth median line on basal two-thirds of pronotum. Sides of pronotum parallel in basal half.

Elytra extremely finely and regularly punctured with a very tiny whitish hair in each puncture. Sutural costa distinct, more convex near apex and nearly as broad near apex as at middle. Submarginal costa evident in apical one-half. Scutellum wider than long with numerous punctures along the sides, each puncture with a fine recumbent hair.

Pygidium rather strongly convex, transverse, the surface nearly regularly and finely punctured. Surface pruinose, nearly devoid of pubescence.

Abdomen narrowly flattened at middle, very finely punctured, except on the penultimate and last segments which have the punctures larger laterally. Penultimate segment with a rather sudden arcuate depression behind anterior one-third. Surface and front margin of depression very finely transversely rugulose. Ultimate segment slightly cupped at middle.

Fixed spur of hind tibia about as broad and two-thirds as long as free spur. Free spur about as long as first hind tarsal segment. Tooth of claw strong and median.

Metasternum very finely punctured, each puncture with a moderately long yellow hair.

Holotype male and two paratype males, Havana, Hale Co., Alabama, V-20-1938, W. B. Jones. The type was presented to me by Mr. H. P. Loding of Mobile, Ala. The paratypes are located in his collection.

The species is named in honor of Doctor Walter B. Jones, Director of the Alabama Museum of Natural History. It is a remarkably distinct and striking species and may be identified without recourse to the genitalia. While possessing a type of genitalia similar to that of *ilicis* (Knoch), there is a distinct perpendicular, somewhat obtuse process on the inside of the right clasper near the middle. The clasper is deeply excavated

laterad of the process. For figures of the genitalia, see Plate I, figures 1 to 3.

Phyllophaga psiloptera n. sp.

Length, 15-16 mm.; width, 8 mm.

The present species is perhaps more closely related to **ignava** (Horn) but is not assignable to any of Horn's groups of the genus.

Form elongate, sub-cylindrical though somewhat wider behind. Color dark reddish-brown. Body above glabrous.

Antennae 10-segmented, the club a little longer than segments two to seven combined. Clypeus slightly though distinctly emarginate with the margins moderately reflexed on each side of middle. Clypeus very densely, irregularly, and somewhat confluent punctured. Front over an area equal to dimensions of clypeus irregularly but not as closely punctured as clypeus, especially on sides. Head behind this area smooth except for a few punctures at sides near eyes. Clypeal suture lightly impressed.

Pronotum with punctures moderately small and irregular, separated from one or two to several times their diameters. A larger central space and lateral spaces nearly smooth. Pronotum very nearly twice as wide as long, the sides in basal half nearly straight though slightly emarginate before the rectangular hind angles. Posterior margin distinctly margined on each side of median one-third to angles. Anterior angles not produced.

Elytra moderately and sub-rugosely punctured. Sutural and sub-sutural costae distinct posteriorly. Elytra gradually wider posteriorly, the widest point at apical one-third.

Pygidium very convex, very coarsely and irregularly punctured. In proportion to the size of the body, the pygidium is smaller than usual in our *Phyllophagas*. The measurements are: length, 4 mm.; width, 2.5 mm.

Abdomen convex, nearly smooth at middle. Punctures much closer and coarser on sides, each puncture with a small decumbent hair. Penultimate segment declivous posteriorly and with a median, circular, coarsely strigose area. Sides of this segment rather coarsely

punctured, the hairs here longer than those on other abdominal segments. Last segment flat, finely strigose at middle.

Both spurs of hind tibia free, slender. One spur distinctly longer than the first hind tarsal segment, the other about two-thirds the length of the longer spur. Tooth of claw small and nearly basal.

Metasternum rather finely and closely punctured, each puncture with a long yellowish hair.

Holotype male and paratype male, Chisos Mts., Brewster Co., Texas, VII-27-1937, Blue Creek, elevation 6000 feet. The two specimens were collected and presented to the Field Museum of Natural History by B. Hartelius. Through the kindness of its director, Mr. C. C. Gregg, I have been permitted to retain the paratype.

This distinct species is to be placed near the **submucida** and **ignava** Groups of Horn by possessing 10-segmented antennae and free spurs on each posterior tibia. It differs chiefly from **ignava** in its entire margins of pronotum, and from members of the **submucida** Group by not having the upper surface of the body iridescent. The genitalia is quite distinctive, and is figured on Plate I, figures 5 and 6.

The right middle leg of the paratype is monstrous and may be worthy of description. The first tarsal segment is rather suddenly enlarged at the tip with the next segment nearly equal in width. From the second segment on the lower side, the last three segments of a second tarsus arise. These segments are, however, more slender than the normal tarsus, and the terminal segment is without claws.

Phyllophaga clemens (Horn)

Lachnosterna clemens Horn, Trans. Am. Ent. Soc. XIV, 1887, p. 227.

Lachnosterna clemens Horn, (Smith) Proc. U. S. Nat. Mus. XI, 1889, p. 496.

Phyllophaga howei Sanderson, Jr. Ks. Ent. Soc. 10, 1937, p. 17.

In Horn's Revision, this species was described and recorded from Florida and Texas, but without more definite localities. At that time the female was unknown. In Smith's paper on the genus, the genitalia of the species

was figured from a specimen supposedly collected in New Jersey and determined by Horn as **clemens**. As far as I know, these are the only records for the species. In 1937, I described and figured a new species under the name of **howei**. While this paper was in press, I learned through correspondence with Mr. O. L. Cartwright of Clemson College, S. C., and Mr. Mark Robinson of Philadelphia, that **howei** was the same as **clemens** Horn. This synonymy was based upon their examination of specimens from the Horn series. According to Horn, **clemens** falls in the **longitarsa** Group by virtue of its 9-segmented antennae, and the very short fixed spur of the hind tibia. My series had this spur well developed. It seems probable that Horn had misidentified the specimen figured in the Smith paper as **clemens**. The figure of Smith appears much like that of **debilis** (Lec.). My figure of the male of **howei** is the correct one for **clemens**.

I have recently examined three more males and one female of **clemens** from Fairfax, S. C. Two of the males were collected May 26, 1932, one male June 4, 1932, and the female on June 13, 1932. Since the female has heretofore remained unknown, it is here briefly characterized.

Agreeing in all essentials with the male except as follows: the antennal club sub-equal to segments 3-6 combined; abdomen convex, smooth; last abdominal segment with a superficial emargination*, the length of the emargination equal to one-third of the length of the segment. There is a row of large punctures along the margin, each bearing a slender hair. The pygidium is one-fourth wider than long. The female is nearly the same size as the males but with the femora and tibiae somewhat stouter. The last ventral abdominal segment is figured on Plate I, figure 4. Careful dissecting of the female failed to disclose any sclerotized structures which we know exist in our species. They may have been lost. It may be of interest to note that fifteen fully developed eggs were found in this female.

Phyllophaga karlsioei (Linell)

This species was described from Arkansas but without definite locality. I have three males from the state as follows: Hempstead Co., May 6, 1929, L. L. Smith, collected on pecan; Franklin Co., April 15, 1938, M. W. Sanderson, in soil; Fayetteville, 1923. Pecan is the first

host recorded for the adult of the species. The internal sac of the genitalia of the Franklin County specimen was artificially inflated and is figured on Plate II. The shape of the sac is similar to that of *ulkei* (Smith), but in a large series of dissected specimens of the latter species from Georgia, the posterior processes at base are horn-like in shape. Other sclerotized processes through the series of *ulkei* were variable in number and shape. For figures of *karlsioei*, *ulkei*, and *fervida* (Fab.), see Plate II.

***Phyllophaga* (Phytalus) *omani* Sand.**

1937. Jr. Kans. Ent. Soc., 10, pp. 66-68.

At the time the species was described, I had but the male type from Burnsville, Ala., and the allotype from Prattsburg, Ga. Since then I have received another male from Mr. P. W. Fattig, Emory University, Georgia, labeled: Thomasville, Ga., May 28, 1938, W. H. Thames, Jr. The specimen was collected on crab apple, this being the first recorded host for the species.

***Phyllophaga* *floridana* Rob.**

1938. Trans. Am. Ent. Soc. LXIV, p. 110.

This species was recently described from St. Petersburg, Florida, from two males and one female. I have examined several additional specimens from Thomasville and Quitman, Georgia, March and April, collected on oak. A single specimen has been seen in the H. P. Loding collection, Gallant, Etowa County, Ala., 1936.

***Phyllophaga* *spreti* (Horn)**

In Mr. H. P. Loding's collection, there is a single male of this rare species labeled: Monte Sano, Madison Co., Alabama, VI-1933, Museum Expedition. This is a new record for Alabama.

***Phyllophaga* *kentuckiana* Ritcher**

1937. Ent. News, LXVIII, p. 285.

I have examined two males in the collection of Mr. Loding from Tombigbee R., Sumter Co., Alabama, May. This is a new record for the state.

* In the space behind the emargination there is a thin, less highly sclerotized structure which occupies all of the emargination.

Phyllophaga lobata Fall

Described from one male and three females from Chiricahua Mts., Arizona. I have seen one male and one female from the Santa Rita Mts., Arizona, collected in July and August. Another female is at hand from S. Catalina Mts., Ariz., July. This is believed to be the first record of the species since the original description.

Phyllophaga elizoria Saylor

1906. *Lachnosterna pygidialis* Schffr., Trans. Amer. Ent. Soc., 32, p. 257.

1937. **Phyllophaga elizoria** Saylor, new name, Rev. de Ent., Vol. 7, p. 321.

I have three males of this uncommon species from Melbourne, Florida, Feb. 17, 1938, Robert Kempfer, collected at light. The species is known only from Florida. The female is unknown, and no host plant has been recorded for the species.

Phyllophaga epigaea (Wickh.)

A little known species described from southwestern Texas. About 65 miles south of Marathon, Texas, on July 10, 1938, Dr. R. H. Beamer and Biological Survey party from the University of Kansas secured several hundred specimens of this species. According to Dr. Beamer, the beetles were crawling about during the day over a creosote-bush flat on which their camp was located. Some of them were observed on the plants, others on the ground, and a number were found copulating. This is one of our few truly diurnal Phyllophagas. Dr. Beamer also secured a single male at Alpine, Texas, one of the original localities from which Wickham received his specimens.

Phyllophaga mariana Fall

Described from a single male from Lake Mary, Florida and since unrecorded. I have seen one specimen in the collection of Mr. C. A. Frost collected at Orlando, Florida, March 20, 1929, at light. The middle lobe of the aedeagus shows the same unevenness in the processes that Fall observed in his specimen but which he thought might be a malformation.

***Phyllophaga schaefferi* Saylor**

1909. *Lachnosterna georgiana* Schffr., Bull. Brook. Inst., I, p. 382.

1937. *Phyllophaga schaefferi* Saylor, new name, Rev. de Entomologia, 7, p. 321.

This species was described from a single male collected in Georgia but without definite locality. In the collection of Mr. C. A. Frost, I have seen a male labeled Florida. From Mr. P. W. Fattig of Emory University, Georgia, I have received one male and several females from Thomasville, Ga., collected from March 29, 1938 to April 4, 1938 on oak and sweet gum. So far as I know these are the first host records given for the species.

***Phyllophaga longispina* (Smith)**

Of this uncommon species I have seen a number of specimens from Dillard, Ga., May and June, collected on persimmon, oak, and chestnut. Specimens were kindly sent to me by Mr. Fattig from Emory University, Ga. From Mr. H. P. Loding, I have received several specimens collected by the expedition from the Alabama Museum of Natural History at Mt. Sterling, Haywood Co., North Carolina, and at Smokemont, North Carolina. Mr. C. A. Frost has a male in his collection which was taken at Framingham, Mass., May. In the collection of the American Museum I have seen several specimens from McDowell Co., N. C., May; Black Mts., N. C., June; and Cornwall, Conn., May. The female is easily separated from the female of *hirsuta* (Knoch) by the emarginate last ventral abdominal segment. In *hirsuta*, this segment is produced in a very small projection at the middle. The male of *longispina* has the inner process of the left clasper vertical while in *hirsuta* the same process is sharply curved. The two species look much alike superficially.

***Phyllophaga subtonsa* (Lec.)**

I have examined several specimens in the collection of Mr. P. W. Fattig from Head River, Ga., collected on June 8, 1937, on hickory and white oak. I have also seen the species from Madison, Jackson, and Etowa Counties, Alabama. Horn does not recognize this species as distinct from *ilicis* (Knoch), and Smith does not mention the species. Glasgow considered it as a valid species

but it seems to have been mentioned by little since. The hairs on the pronotum of **subtonsa** are generally more erect than in **ilicis**, and the posterior margin of the right clasper in the males of **subtonsa** is rounded and not deeply emarginate as in **ilicis**. The two are probably confused in collections.

Explanation of Plate I

- Fig. 1. **Phyllophaga jonesi** n. sp., right clasper of aedeagus.
- Fig. 2. **Phyllophaga jonesi** n. sp., dorsal view of aedeagus.
- Fig. 3. **Phyllophaga jonesi** n. sp., left clasper of aedeagus.
- Fig. 4. **Phyllophaga clemens** (Horn), last ventral abdominal segment of female.
- Fig. 5. **Phyllophaga psiloptera** n. sp., dorsal view of aedeagus.
- Fig. 6. **Phyllophaga psiloptera** n. sp., right lateral view of aedeagus.
- Fig. 7. **Phyllophaga lodingi** n. sp., right clasper of aedeagus.
- Fig. 8. **Phyllophaga lodingi** n. sp., dorsal view of aedeagus.
- Fig. 9. **Phyllophaga lodingi** n. sp., left clasper of aedeagus.
- Fig. 10. **Phyllophaga lodingi** n. sp., public process of female.
- Fig. 11. **Benedictia pilosa** n. gen. and sp., dorsal view of aedeagus.
- Fig. 12. **Benedictia pilosa** n. gen. and sp., right lateral view aedeagus.

Explanation of Plate II

- Figs. 1 to 5. **Phyllophaga ulkei** (Smith), figures showing variation in internal or copulatory sacs of males.
- 6. **Phyllophaga karlsioei** (Linell), copulatory sac of male.
- 7. **Phyllophaga fervida** (Fab.), copulatory sac of male.

Plate I

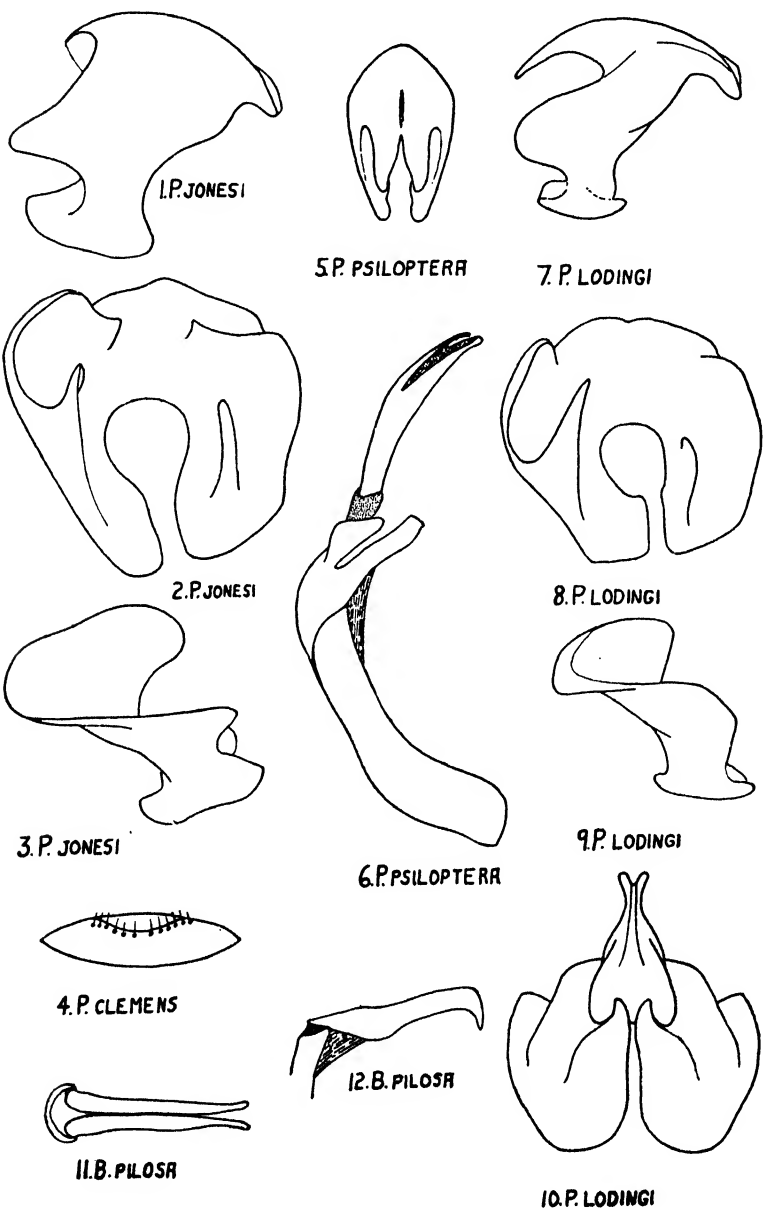
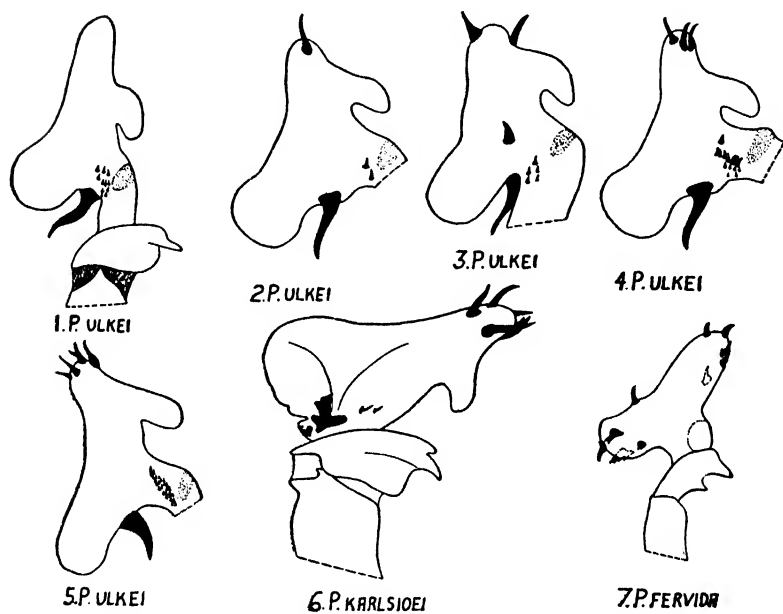


Plate II



NEW NEARCTIC PIPUNCULIDAE (DIPTERA)

D. ELMO HARDY, Lawrence, Kansas*

Key to known Nearctic *Verrallia*

1. Last section of fourth vein appendiculate 2
 Last section of fourth vein normal 3
2. Stigma long, as long as third costal section.
 *virginica* Banks
 Stigma short, not over one-half third costal
 section *opaca* (Williston)
3. Fourth section of costa at least twice as long
 as third *pilosa* (Zetterstedt)
 Fourth section of costa shorter than third.
 *fasciatus* n. sp.

Verrallia fasciatus n. sp.

This species appears to more closely approach *pilosa* (Zett.) than *virginica* Banks but differs markedly from this species in having the fourth section of the costa longer than the third, stigma not over one-half the length of the third section; bristles all black; front silvery; ocellar bristles strong; halteres yellow; humeri black; piercer of ovipositor longer, more slender and femora without tuberosity.

Female.—In addition to the above characters the first two segments of the antennae are black, the second with stout black bristles above and fine, long, yellow pile beneath; the third segment brown and reniform, with a fringe of yellow white pile (fig. 1b). **Head:** Face and front silvery, this being brought about by the dense covering of silver pubescence. Face convex from lateral view. Front slightly narrowed at the halfway point between antennae and the vertex, the sides not being parallel as in *pilosa*. Occiput chiefly silvery but scarcely visible from side view.

Thorax: Opaque gray, slightly brownish on the posterior half of mesonotum. Pleurae, mentantotum and scutellum, also posterior one-half of each abdominal segment, silvery gray. Bristles of the thorax strong, four pairs on the scutellum; all bristles black except for two to three pairs of notopleurals which are yellow. Dorsum

* Contribution from Department of Entomology, University of Kansas.

with rather abundant yellow pile. **Legs:** Coxae, trochanters and femora black with gray pollen, extreme tip of femora, tibiae and tarsi yellow, last two tarsal segments brownish. Femora without tubercles or strong bristles, but with numerous rows of long yellow hairs.

Abdomen: Slightly tapering, as viewed from above, widest at segments one and two. First two segments opaque brownish on their anterior halves, segment two one and one-third times longer than third. Segments three, four and five subopaque black anteriorly, fifth segment one and one-fourth times longer than fourth and about equal to sixth; sixth tergite somewhat pointed on its posterior margin. Segments six and seven entirely gray dusted, faintly shining, seventh protruded, long and narrow, serving to elongate the base of the ovipositor. First abdominal segment entirely yellow pilose, densely haired on the sides; second segment chiefly so, with one row of black hairs on the posterior border, hairs of abdomen otherwise black. Ovipositor elongate, gently tapering from the base into a long narrow piercer extending beyond anterior portion of third segment (fig. 1c).

Wings: Hyaline, faintly iridescent; third costal section three-fourths as long as fourth. Stigma brown, almost completely filling third costal section. Third and fourth costal sections equal to or little longer than fifth. Ultimate section of fourth vein slightly sinuate, last section of fifth longer than posterior crossvein. Anal cell with a long petiole. Crossvein r-m at about middle of the third costal section and before middle of discal cell (fig. 1a).

Length: Wing, 5 mm.; body, 4.3 mm.

Male unknown.

Holotype female, Durango, Colorado, July 2, 1937, C. L. Johnston. In the Snow Entomological collection.

***Pipunculus atramontensis occidens* n. var.**

The specimens at hand differ from the original description of the species in having the antennae black (third segment brownish black), the third segment not so long pointed (fig. 2b). The hypopygium is longer than the fifth segment, viewed from the side, and has a flat slightly convex area on its apex, simulating an apical cleft (fig. 2a). This area may or may not be interpreted as a cleft. It is not deeply grooved but is distinct-

ly indented in the center; as viewed from above, however, it would appear to be a cleft. Banks and Cresson¹ made no mention of this character in the description of **atramontensis** and this may prove to be a distinct species. The posterior portion of the abdomen is somewhat more swollen than the type variety as figured by Cresson and the specimens are slightly smaller in size. Length: wing, 4.5-4.7 mm.; body, 3.5-3.7 mm.

The following observations would be added to the original description of the species: Occiput subshining black above, silvery below. Mouthparts bright yellow. Comb of first abdominal segment composed of long grayish yellow hairs; the hypopygium is rather large as compared to other *Pipunculidae*. Stigma very minute, barely discernible in the apical portion of third costal section. Second costal section of wing less than one-third the length of the fourth section in **atramontensis** Banks, about one-fifth its length in **atramontensis occidentis**. Ultimate section of fifth vein shorter than posterior crossvein, last section of fourth vein slightly curved; anal cell with a very short petiole.

Female unknown.

Holotype male, Potlatch, Idaho May 28, 1930 (J. M. Aldrich); paratype male, same data as holotype. Holotype returned to the United States National Museum, paratype retained in the Snow Entomological Collection.

***Pipunculus contortus* n. sp.**

This unusual species remotely resembles **trochanteratus** Malloch in having the posterior trochanter tuberculate but differs greatly from this or any other known previously described species. It is distinguished from all other **pipunculus** in having the post-tibiae and femora strongly contorted (fig. 3d) and the hypopygium densely haired (fig. 3a).

Male.—Head: Face silvery pubescent, front golden (in ungreased specimens). Eyes contiguous for only a short distance on the upper part of the front. Sides of occiput silvery pollinose, upper part and vertex subshining. Third antennal segment short acuminate (fig. 3c), brownish in ground color.

¹ Studies in North American Dipterology: *Pipunculidae*, Trans. Amer. Ent. Soc., Vol. XXXVI, 1911.

Thorax and abdomen: Lightly gray pollinose, but slightly shining and covered with very fine, short brownish pubescence. Pleurae, metanotum and sides of abdomen more conspicuously grayed. Humeri and halteres bright yellow. **Legs:** Chiefly black except for extreme apices of femora and tibiae, broad bases of tibiae and first two tarsal segments which are yellow; other tarsal segments brown to black. Femoral spines very weak.

Abdomen: Somewhat rounding, broadest at segments two and three; segment five about one and one-third times as long as four. **Hypopygium:** About one-half as long as fifth segment, densely brown to black haired, only slightly compressed to the right and with a slight apical cleft (fig. 3b).

Wings: Hyaline, without stigma. Third costal section short, about one-third to one-fourth the length of the fourth section (fig. 3e). Crossvein r-m situated at the middle of the discal cell, just beyond the middle of the fourth costal section.

Last section of fourth vein slightly sinuate; ultimate section of fifth vein equal in length to the posterior crossvein. Petiole of anal cell long.

Length: wing, 3.3 mm.; body, 3 mm.

Female unknown.

Holotype male, Douglas Co. Ks. Sept. 30, 1933 (H. M. Smith). Two paratype males, Manhattan, Ks. July 29, 1930 and June 10, 1932 (D. A. Wilbur).

The holotype and one paratype are being returned to Kansas State College; one paratype is retained in the Snow Entomological Collection.

***Pipunculus femoratus curvitiibiae* n. var.**

These specimens run to ***aequus*** Cresson in Cressons key but morphologically are the same as ***femoratus*** Cresson and no doubt they belong to that species.

This variety differs in having the antennae blackish, tinged with yellowish brown; thorax and abdomen clothed with long rather dense, yellow-gray pile; femora brownish black, yellowed basally and apically. Abdomen opaque to sub-shining brownish pollinose, dusted with gray on the sides and posterior margins of the seg-

ments. The posterior tibiae seem more strongly curved and the femora more spinose (fig. 4a) than is shown in Cresson's figure of *femoratus*.

Length: wing, 5.8-6 mm.; body, 5.3 mm.

The following observations might be added to the original description of the species: Comb of first ad-dominal segment grayish yellow, hypopygium about three-fourths as long as fifth segment, as viewed from above. Third costal section of wing and stigma much shorter than fourth section, not over three-fourths as long; last section of fourth vein strongly sinuate, ultimate section of fifth vein shorter than posterior crossvein. Anal cell with a medium lengthed petiole; r-m crossvein at or but slightly beyond end of auxiliary vein and at basal one-third of discal cell.

Holotype male, Cave Cr. Can., Chiricahua Mts., Ariz. 5500 ft. One paratype, same data as holotype, also one specimen from White Mts., N. M. Rio Ruidosa, Alt. 6500 ft. (Townsend). The latter specimen is not being set up as a paratype but seems to belong here; the abdomen is slightly shining.

The holotype is being returned to the United States National Museum. The paratype deposited in the Snow Entomological Collection.

***Pipunculus knowltoni* n. sp.**

This species runs to *insularis* but is markedly different from this tropical species. The post-trochanter has a very distinctive, narrow ridge on the under portion, densely covered with minute, silvery matted pubescence (fig. 5a) and the hypopygium is much shorter than the fifth segment.

Male.—Head: Front and face silvery, front slightly browned above. Eyes contiguous for about one-third the length of the front. Mouthparts yellow-brown. Antennae black; third segment white pubescent, long acuminate below (fig. 5b). Occiput silvery on the sides, dusted black above.

Thorax and abdomen: Subshining to metallic, very faintly cinereous, the gray coloration is produced by microscopic pubescence; the abdomen is sparsely covered with short black hairs. Scutellum shining; metathorax densely gray pollinose; humeri whitish; halteres yellow.

Meso- and propleurae subshining, rest of pleurae cinereous. **Legs:** Chiefly black with only tarsi, apices of femora and bases of tibiae yellow. Front and mid coxae, trochanters, inner sides of all femora shining. Posterior coxae cinereous, strongly flattened. Femoral spines weak, femora not swollen. **Abdomen:** Sides straight or nearly so, not tapering until fifth segment. Lateral comb of first segment composed of several long black hairs. Fifth segment one and one-third as long as fourth. **Hypopygium:** About three-fourths as long as fifth, sub-hemispherical, not compressed; with a distinct cleft on the right side (fig. 5c). Ventral process black, extending to about third segment.

Wings: Hyaline; third costal section about one-half the length of fourth; r-m crossvein situated beyond end of first vein and middle of discal cell. Ultimate section of fourth vein slightly curved but not sinuate, last section of fifth about as long as post-crossvein. Petiole of anal cell of medium length.

Length: body, 3mm.; wing 3.3 mm.

Female.—The female approaches *albiseta* Cresson but differs in having shorter ovipositor, with a distinct tubercle at the base (fig. 5d). This tubercle is more strongly developed on some specimens and the ovipositor seems to vary in length. Front silvery to the vertex, otherwise like the male.

Holotype male, Cache Junction, Utah, August 23, 1938 (G. F. Knowlton and D. E. Hardy). Allotype female, Manhattan, Kansas, September 14, 1933 (D. A. Wilbur). Paratypes, thirty-two males and twenty one females, same locality and collector as allotype, collected from June 30 to September 28, 1930 to 1937; one male, same locality, 5 Sept. 31 (H. M. Smith); one male, same locality, October 8, 1929 (T. F. Winburn). One male, Harker Co., Oklahoma July 23, 1933 (R. H. Painter); male, Page, Oklahoma, June 23, 1937 (Standish-Kaiser) and two males, Stillwater, Oklahoma, Sept. 10, 1938 (R. W. Kaiser). One female, Trout Creek, Utah, Sept. 18, 1938, Meadow sweeps (G. F. Knowlton and F. C. Harmston); one female, Johnson, Utah, Sept. 12, 1938, Meadow sweeps (G. F. Knowlton and F. C. Harmston); one female, Franklin Co., Kansas, June 8, 1923. (R. H. Beamer) and one female, Spearville, Kansas, September 7, 1938 (D. E. Hardy and A. T. Hardy).

This species was originally described, in manuscript, from the holotype male. A large series of these were later found in the Kansas State College collection and have been incorporated in this description. It has been named in honor of Dr. G. F. Knowlton who with the writer collected the holotype and under whose direction this study was begun.

The holotype and a number of paratypes are being deposited in the United States National Museum. The allotype and a share of the paratypes at Kansas State College; the remainder of paratypes at Utah State Agricultural College, Oklahoma A & M College and the Snow Entomological Collection.

***Pipunculus wilburi* n. sp.**

This species approaches *P. trochanteratus* Malloch but differs in having a conspicuous long apical spur on the mid-coxae (fig. 6c) and long tooth on post-coxae of the male.

Male.—Head: Eyes contiguous for one-third to one-half the length of the front; face and frontal triangle silvery. Occiput gray on the sides, subshining above. First two antennal segments black, third segment brown with gray pruinosity and whitish fringe; third segment short acuminate, style not greatly thickened basally (fig. 6b).

Thorax and abdomen: sub-shining, very lightly dusted with gray, the dust being more perceptible on the sides and apices of abdominal segments and on the pleurae of thorax; metanotum more grayed. **Legs:** Black, except for narrow apices of femora and tibiae, broad bases of tibiae and first four tarsal segments which are yellow; fifth tarsal segment, brownish. Front femora with two small flexor hairs near their bases on the under side. Spur of mid-coxae about one-half the length of the segment, and about equal to the trochanter in length. Tooth of posterior trochanter tapering (fig. 6d). Femoral spines weak, only slightly developed on apical one-third of segment. Dorsum of thorax and humeri with scattered black hairs, humeri whitish yellow. Knobs of halteres yellow, bases dark.

Sides of abdomen somewhat straight, gradually tapering posteriorly, widest at segments two and three.

Hypopygium: compressed to right, elongate and slightly pointed apically; cleft on the right side and with a large apical keel.

Wings: Hyaline, slightly fumed; third costal section approximately one-third the length of fourth; third and fourth section two-thirds as long as fifth. Stigma absent; r-m crossvein situated beyond middle of fourth costal section and at the middle of the discal cell.

Length: wing, 3.4 mm.; body, 3.1 mm.

Female.—

Front silvery to the vertex, slightly concave in the middle. Front and mid-femora with two to three stout black hairs on the under side near bases; post-trochanter with a small clump of short, black hairs beneath. Piercer of ovipositor slender, reaching past posterior margin of second segment, gradually tapering from its globose base (fig. 6a).

Holotype male, Manhattan, Kansas, Oct. 6, 1933 (D. A. Wilbur). Allotype female, same locality and collector, May 12, 1933. Paratypes, seven males and five females, same locality and collector, collected from July to September, 1930 to 1937; and one female, Riley Co., Ks., April 30, (F. Marlatt). The holotype, allotype and a series of paratypes are being returned to Kansas State College; the rest retained in the Snow Entomological collection.

The species is named in honor of Professor D. A. Wilbur, who collected this series of specimens as well as the majority of specimens of **knowltoni** and **contortus**. These were taken in association with their Homopterous hosts in grass plots.

Explanation of Plate

Fig. 1 **Verrallia fasciatus** n. sp.

a. wing; b. head; c. lateral view of abdomen.

Fig. 2 **Pipunculus atramontensis occidentis** n. var.

a. posterior portion of male abdomen, dorsal view;
b. antenna.

Fig. 3. **Pipunculus contortus** n. sp.

a. posterior portion of male abdomen, lateral view;
b. male abdomen, dorsal view; c. antenna; d. posterior trochanter, femur and tibia of male; e. costal section of wing.

Fig. 4 **Pipunculus femoratus curvitibiae** n. var.

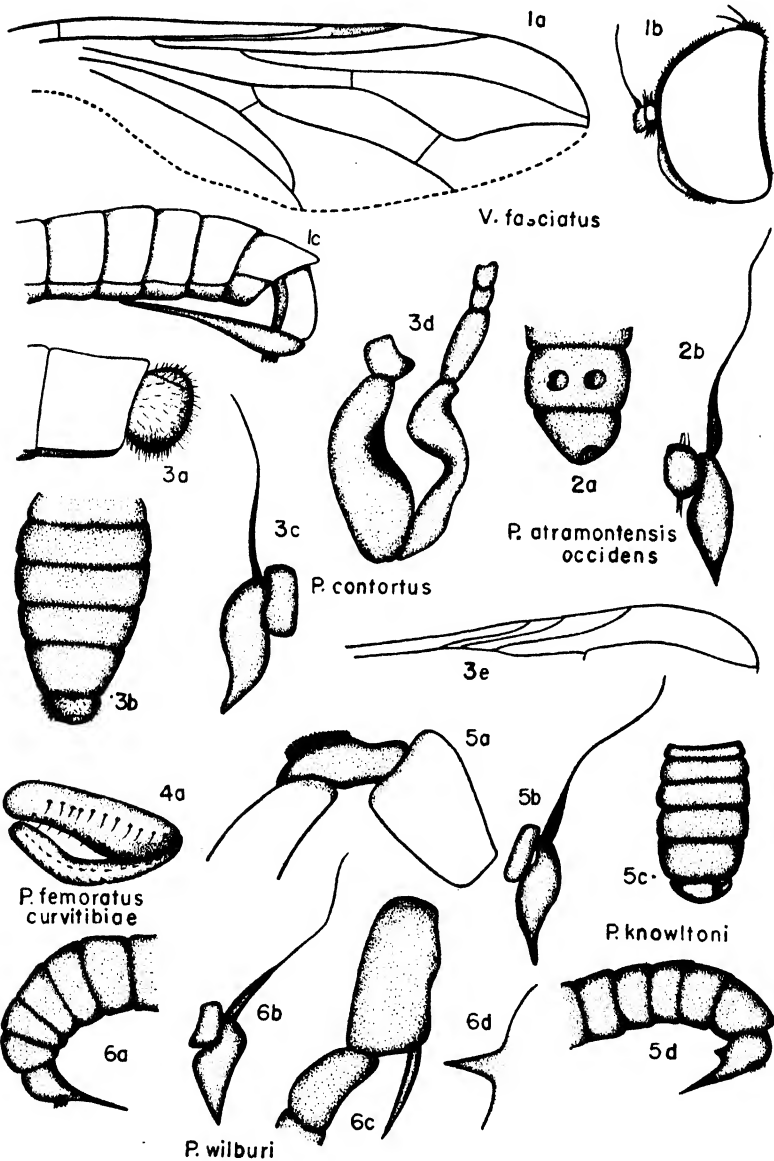
a. posterior femur and tibia.

Fig. 5 **Pipunculus knowltoni** n. sp.

a. posterior trochanter and coxa of male; b. antenna; c. abdomen of male, dorsal; d. female abdomen, lateral view.

Fig. 6 **Pipunculus wilburi** n. sp.

a. abdomen of female, lateral view; b. antenna;
c. mid-coxa and trochanter of male; d. outline of posterior trochanteral tooth, male.



FOUR NEW SPECIES OF LEAFHOPPERS AND NOTES
ON TWO OTHERS (HOMOPTERA,
CICADELLIDAE)

R. H. BEAMER, Lawrence, Kansas*

Lonatura rotunda n. sp

Resmbling *Lonatura salsura* Ball, but with elytra of short winged form with apices round instead of truncate, color markings usually pronounced, aedeagus of male longer, with bifurcation of tip much narrower. Length: short winged form, 3.50-4 mm; long winged form, 4.50-4.75 mm.

Vertex rounded, not quite so sharp as in *L. salsura*. Elytra in short winged form having last three segments of abdomen exposed; apices rounded; hind wings mere pads; wings longer than abdomen in long winged form, both well developed.

Color. Ground color buff to whitish hyaline, marked with fuscous. Vertex with two black spots on front margin, mesal one more or less triangular; back of these a transverse dash enlarged at either end and a pair of converging dashes basally. Pronotum usually with four distinct longitudinal stripes, often quite dark in long winged forms. Scutellum usually with apex and basal angles darker. Elytra subhyaline, veins white with usually some darker areas, especially on clavus.

Genitalia. Last ventral segment of female about twice as long as preceding, lateral margin excavated for about half its length exposing underlying membrane, posterior margin slightly produced at middle. Male valve short, rounded. plates wider than valve at base, rapidly narrowed to sharp apices; aedeagus in lateral view broad, bent dorsally on outer third with slight indentation of margin at that point; apex in ventral view with narrow mesal slit about two-thirds as long as greatest width of shaft.

Holotype male, allotype female, 15 male and 18 female paratypes, Swan River, Manitoba, August 2, 1937, R. H. Beamer; 4 female and 8 male paratypes, Cowan, Manitoba, August 7, 1937, R. H. Beamer. (All short winged); 3 female and 3 male long winged forms, same

* Contribution from the Department of Entomology; University of Kansas.

data as latter; 1 long winged female, Birch River, Manitoba, August 3, 1937, R. H. Beamer.

Twiningia tricolor n. sp.

Resembling **T. bicolor** (Ball) but dorsum crossbanded with three colors, white, fuscous, and orange. Length; female 4 mm.; male 5 mm.

Vertex deeply excavated, margins very sharp. Elytra longer than abdomen, apices rounded, with two claval veins, outer indistinct, two cross-nervures and appendix.

Color. White with following crossbands: mottled fuscous occupying pronotum, scutellum and bases of elytra, golden yellow from about middle of clavus almost to cross veins and fuscous from cross veins to apices. White basal color shows as narrow band on both sides of yellow band. Apical cells usually with a light areole in base. Venter golden yellow except fuscous cross band of pronotum which occupies a portion of face and all of sternum, including legs to tibiae.

Genitalia. Last ventral segment of female about three times as long as preceding; posterior margin roundly produced, sharply excavated one-half its length either side of long ribbon-like process which in turn has a sharp V-shaped notch in apex one-third its length. Male valve longer than preceding, angular; plates about as wide at base as valve, outer margin arcuately narrowed to very sharp apices, extending beyond pygofer. Pygofer almost rectangular in shape, with rather blunt tooth on outer ventral corner; aedeagus in ventral view narrow, but with a broad appearance due to a process on each side that is wider than aedeagal shaft, curves with and extends one-fourth its length beyond its apex; in lateral view widest at base, curving dorsally, to form semicircle, margins converging to very slender, sharp apices.

Holotype male, allotype female, 4 male and 12 female paratypes, Anza, California, July 29, 1938, R. H. Beamer; 4 male and 8 female paratypes, Idyllwild, California same date and collector. These specimens were swept from **Arctostaphylos pungens** H. B. K.

Brazosa sexpunctata n. sp.

Resembling **amazonensis** (Osb.) but pronotum not minutely punctate, elytral veins distinct, not marked

with fuscous, but two transverse spots on vertex, none on scutellum. Length: male, 5 mm.; female, 6 mm.

Vertex very slightly wider at middle than next eyes, slightly more than three times as wide as long, convex, strongly rounding from base to front. Elytra with one crossnervure, longer than abdomen with rounded apices.

Color tawny with usually a small pair of black spots on the front, another on the vertex and a third pair on the pronotum. One specimen in the five has an indication of a pair of median, longitudinal, orange red stripes, united at apex, separating and crossing vertex, pronotum and scutellum and another broader stripe back of each eye. Elytra semihyaline, veins more tawny.

Genitalia. Last ventral segment of female more than twice as long as preceding, posterior margin truncate with very small median notch. Male valve very small, sharply angular; plates much wider at base than valve, long, outer margin converging to long, sharp apices, inner margins slightly diverging on outer third.

Holotype male, allotype female and 3 female paratypes, Brownsville, Texas, August 8, 1937, D. J. and J. N. Knull.

***Deltocephalus luteoapicalis* Beamer**

***Deltocephalus luteoapicalis* Beamer, R. H. Jour. Kans. Ent. Soc., July, 1938, p. 81.**

Male like the female but smaller and the elytra longer than the abdomen. Length: male, 2.5 mm.

Genitalia. Valve about one-third longer than preceding segment, angular; plates wider at base than valve, narrowed on outer margin to rather sharp, rounded apices; aedeagus in lateral view very wide at base, rapidly narrowing near middle to one-fourth basal width, bending dorsally at right angles at this point, narrowing on to apex where it is flattened slightly and bent basally. Pygofer more or less rectangular with a fairly large tooth on the outer dorsal corner; margins minutely serrate from tooth to ventral margin.

Allotype male, 13 parallotypes and 20 females, Peeler, Texas, June 22, 1938, R. H. Beamer.

***Dicyphonia minuta* Beamer**

***Dicyphonia minuta* Beamer, R. H., Jour. Kans. Ent. Soc., p. 70, 1936.**

Female resembling *D. plana*, but vertex distinctly wider than long and disc more highly arched on basal half. Length 5.5 mm.

Vertex distinctly wider than length between eyes, disc highly arched on basal half, margins evenly curved from eye to apex, almost foliaceous. Elytra short, exposing four abdominal segments; cut off near apex of clavus, apices slightly rounded; venation fairly distinct although somewhat obscured by vermiculate marks.

Color cinereous with fuscous marks about as in *D. plana*.

Genitalia. Ovipositor projecting; last ventral segment about three times as long as preceding, posterior margin truncate with small median tooth.

Allotype female, Laramie, Wyoming, July 13, 1937, R. H. Beamer. Parallotypes numerous specimens same time and place, R. H. Beamer, C. L. Johnston, and H. T. Peters.

It was only by getting down in the grass and brushing and parting it with our hands that we were able to find the females. These were collected at the type locality, about five miles north of the city of Laramie, Wyoming, on the west side of the road.

Erythroneura extima n. sp.

Resembling *nitida* Beamer, but abdomen light; anterior point of style much longer, posterior point much shorter and processes on shaft of aedeagus on sides about one-fourth distance from apex, very short.

Ground color white tinged with yellow on head, pronotum and scutellum. Vertex with inverted orange V, usually touching eyes, continued across pronotum as two diverging vittae; scutellum with basal angles yellow. Elytra with inner pair of oblique vittae, usually bright red, costal pair lemon yellow; sometimes a slight infuscation in region of cross-veins. Abdomen light.

Genitalia. Style with slender foot, base slightly excavated; anterior point long and heavy, longer than width of foot next points; posterior point short, not over one-third as long as anterior, both points directed obliquely to foot; heel usually small. Aedeagus in lateral view slightly curved dorsally, almost parallel-sided with a pair

of short, lateral processes about one-fourth distance from tip.

Holotype male, allotype female, two male and 5 female paratypes, Cedar River, Michigan, August 26, 1937, R. H. Beamer.

DISTRIBUTION OF THE VEGETABLE WEEVIL IN ARKANSAS

DWIGHT ISELY

University of Arkansas, Fayetteville

The vegetable weevil (*Listroderes obliquus* Klug.) has been known as a pest of various truck crops in Arkansas since 1936, and now appears to be widely distributed over the state. It was first noted in the state because of local injury in Bradley county in southeastern Arkansas, early in May, 1936¹. A number of other records of local destructiveness were secured from nearby counties, Drew, Ashley, and Chicot, also in southeastern Arkansas. In 1937 the species was abundant enough to cause damage as far west as Hot Spring county¹ in the central part of the state and as far north along the eastern border as Crittenden county within 60 miles of the Missouri line. Also a single specimen was collected June 14, 1937, at Fayetteville in Washington county in the northwestern part of the state. In 1938, between March 25 and May 31, four additional specimens were collected at a trap light by M. W. Sanderson at Fayetteville². No injury by this pest has been observed in northwestern Arkansas. All reports of injury have been received by the Department of Entomology during the month of May.

Up to the present time most of the records of injury by the vegetable weevil have come from the southeastern part of the state, which is nearest to southern Mississippi where it was first observed in the United States in 1922. The infestation at Fayetteville is still in the stage where only isolated specimens are taken. Owing to the scattered distribution of records secured it may be expected that the species occurs rather generally over the state. It is probable that its spread over Arkansas is not as rapid as these records might suggest, but that the insect was established in the southeastern part of the state some years before it became abundant enough to cause injury.

¹ Specimens determined by L. L. Buchanan.

² Specimen determined by L. S. Henderson.

**UBER ENTOMOLOGISCHE SAMMLUNGEN—
WALTHER HORN**

Students interested in insect taxonomy will be pleased to know that Doctor Walther Horn has completed his "Uber entomologische Sammlungen." This splendid work is indispensable to those interested in the location of types and collections.

The addition of 26 plates giving the reproduction of determination labels in the handwriting of workers past and present is most useful in judging the authenticity of determinations and historic material. The list of workers is arranged alphabetically and is followed by a Nachtrag of 75 pages giving additional names. This valuable work appeared as follows:

Part I Entomologische Beihefte aus Berlin-Dahlem.

Band 2, pp. 1-160 plus 16 plates contains A to Lull (Dec. 14, 1935)

Part II Ibid

Band 3, pp. 161-296 plus 10 plates contains Luet to Waterhouse. (Oct. 4, 1936)

Part III Ibid

Band 4, pp. 297-388. Waters to Zivick and supplementary list. (Aug. 1, 1937).

H. B. HUNGERFORD

NOTICE

The Fifteenth Annual Meeting of the Kansas Entomological Society will be held April 1, 1939, at the University of Kansas, Lawrence, Kansas.

Members wishing to present papers should submit titles to the Secretary not later than March 1, 1939.

H. H. Walkden, Secretary-Treasurer
1204 Fremont St.,
Manhattan, Kansas.

STUDIES IN NEOTROPICAL STRATIOMYIDAE (DIPTERA)

MAURICE T. JAMES
Colorado State College

The following paper presents studies, in the form of short reviews, of three genera of Stratiomyidae which are found chiefly or exclusively in the Neotropical Region. For the material studied, I am indebted to many individuals and institutions, but especially to the American Museum of Natural History, the Museum of Comparative Zoology, the University of Kansas, the Deutsche Entomologische Institut, Doctor S. W. Frost, Doctor J. Bequaert, Doctor M. Bequaert of Gand, Belgium, and Doctor John Lane of the Sao Paulo Museum, Brazil.

I The American Species Formerly Referred To *Chrysoclora* Latreille.

The genus *Chrysoclora* was established in Cuvier's *Regne Animal* (1829), by Latreille, for *Sargus amethystinus* Fabr., from Mauritius, the only species mentioned. Enderlein has no authority, so far as I can determine, for considering *Sargus vespertilio* Fabr. the type.

Williston (*Biologia Centr. Amer.*, Dipt., 242) has questioned the generic position of the American species which have been referred to this genus, on the basis of the metallic coloration of *amethystina* and the statement of Macquart that the eyes of the males are contiguous. An examination of the genotype shows that this query was well-founded. *C. amethystina*, male, has a short antennal flagellum, which, excluding the arista, is slightly shorter than the combined length of the first and second segments; structurally, however, it is as in the American species: the eyes are broadly contiguous; the scutellum is triangular (not much different, however, from that of *frosti* described below); vein R2+3 arises beyond cross-vein r-m by a distance much greater than the length of the cross-vein; the part of the discal bordering the fifth posterior cell is by far shorter than that bordering either the second, third, or fourth posterior cell; the discal cell, therefore, tends to be more acute apically; and the body is predominantly metallic. In respect to these characters, it seems that *amethystina* may stand alone. According to Miss Ricardo's descriptions (*Insects of Samoa*, Dipt. 113-115) and Terzi's excellent illustrations, *C. luteipes* Ric. and *C. insularis* Ric. are like the American species

except for a somewhat metallic coloration. (Miss Ricardo described, however, only the females). I do not know the other Old World species, *C. lineata* de Meij., but it is probably also like the American ones.

These considerations force the following issue: whether to propose a new generic name for the American species, or to leave the heterogenous combination as it now stands. Either course offers serious objections. On the one hand, it is undesirable to change a well-known generic name that has for more than a century been applied to a group of species, and leave that name restricted to a single one; the other course would, however, if carried to its logical conclusion, demand the union with *Chrysochlora* of such genera as *Chromatopoda* and *Cacosis*, which, though possessing good generic characters, are no more distinct from *C. amethystina* than that species is from *C. vespertilio* and its allied species.

I am therefore proposing the following generic name for the American species.

***Chrysochlorina* James, gen. nov.**

Antennae elongated, longer in the female than in the male, the flagellum elongated-conical and ending in a long, bare bristle. Eyes bare, broadly separated in both sexes. Scutelleum unspined, usually rounded, sometimes almost triangular. Venation strong, the posterior veins reaching almost or quite to the posterior margin; vein R2+3 interstitial with cross-vein r-m, or almost so; sides of the third posterior cell almost parallel; the fifth posterior broadly contiguous with the discal cell, the extent of the contact being at least as broad as that of the second, and usually that of the third and fourth, posterior cells. Abdomen at least as broad as, usually broader than, the thorax. Large, usually predominantly yellowish or greenish, sometimes black or metallic, flies.

Genotype, *Chrysochlorina* (*Sargus*) *vespertilio* (Fabricius) 1805.

Key to species.

The following key, adapted, with modifications, from that of Curran (Amer. Mus. Nov., 339, p. 2, 1929), contains the described Neotropical species.

- | | |
|---|----|
| 1. Front with black vitta or largely black | 2 |
| Front yellow, at most the ocellar triangle brown..... | 10 |
| 2. Face yellowish, at least in part | 3 |
| Face blue or green | 9 |

3. Mesonotum vittate 4
 Mesonotum not vittate 8
4. Scutellum yellowish, the base black 5
 Scutellum black, the apex broadly yellowish
 (Cuba) **quadrilineata** (Bigot)
5. Second abdominal segment without a median
 pale vitta 6
 Second segment with a median pale vitta
 (Brazil) **pluricolor** (Bigot)
6. Wings with a dark cloud at the middle and one
 near the apex (Brazil) **willistoni** (Curran)
 Wings evenly clouded on the apical half, at least
 in front 7
7. Costal border evenly brown; the abdominal
 segments with transverse black bands (Guiana)
 **castanea** (Macquart)
 Costal border not noticeably darker than the
 apical half of the wing; abdominal segments
 each with a median black spot (Colombia)
 **femoralis** (Curran)
8. Thorax and abdomen almost wholly shining
 black (Panama, Colombia) **frosti** James, n. sp.
 Thorax and abdomen not shining black
 (Galapagos) **fasciata** (Thomson)
9. Front with two yellow spots anteriorly
 (Venezuela) **maculiventris** (Rondani)
 Front wholly metallic (Mexico)
 **purpurea** (Walker)
10. Pleura and pectus wholly yellow 11
 Pleura and pectus in part brownish or black 12
11. Thoracic stripes black, black-pilose behind the
 suture (Brazil) **incompleta** (Curran)
 Thoracic stripes reddish brown, yellow pilose
 (Yucatan) **flavescens** (James)
12. Pectus in part black 13
 Pectus wholly pale, scarcely darker than the
 pleura (Guiana, Colombia, Bolivia)
 **varia** (Curran)
13. Costal border of wings broadly and evenly brown
 (Brazil) **similis** (Macquart)
 Costal border luteous or not evenly brown 14
14. Wings with a median and apical brown spot on
 the anterior half (Brazil)
 **vespertilio** (Fabricius)
 Wings evenly luteous in front 15

15. Posterior tibiae and tarsi white, the legs yellow,
the color strongly contrasting (Brazil)

..... **albipes** James, n. sp.
Legs yellow, sometimes in part darkened (Mexico)
..... **pulchra** (Williston)

***Chrysochlorina frosti* James, new species**

Male. Eyes, at narrowest point (vertex) separated by a distance of about two and one-half times the diameter of the ocellar triangle; sides of vertex and of the upper part of the front almost parallel, the lower part of the front and the face becoming gradually broader. Front, below the ocellar triangle, with a tubercle, which is sharply margined laterally. Vertex and upper part of front deep black; the lower part of the front and the face dirty yellow; the median vitta of the front brownish, however, to its lower third, this area with numerous fine, irregularly arranged, striae. Face brownish below; cheeks black. Occiput black, except just behind the ocellar triangle, where it is green or yellow. Proboscis bright yellow. First and second antennal segments a dirty yellow; the flagellum and arista black. Head, including antennae, with black pile. Thorax black, black-pilose; the humeri and four small spots, two at the anterior margin of the mesonotum and one on each side before the suture, green; the posterior margin of the scutellum green; the post-alar calluses and sometimes parts of the metapleura slightly greenish. Scutellum terminating in somewhat of a tubercle. Femora black, with black pile; the anterior femora yellowish on the apical third or half, but the pale area gradually merging into the black; tibiae and tarsi light yellow, with concolorous pile. Wings ochraceous along the costal third, brown at the apex and on the posterior third, pale yellow in the middle; veins yellow, except that they become brown in the regions of the brown membrane; venation typical. Halteres green. Abdomen black, wholly black-haired; a small, semi-circular, greenish spot on the first segment; sometimes the lateral margins and the anterior corners very briefly greenish or yellow; in some specimens, a pair of large yellowish spots on the second segment; venter black, black-haired. Genitalia bright yellow, black-haired. Length, 15-18 mm.

Holotype: male. Barro Colorado Island, C. Z., Jan. 5, 1929 (C. H. Curran). In the American Museum of Natural History.

Paratopotypes: 4 males, Barro Colorado Island, Dec. 15, 1936, April 19, 1937, and May 5, 1937 (S. W. Frost).

Paratype: male, Muzo, Dept. Boyaca, Colombia, 900 meters, 1936 (J. Bequaert).

The characteristic tubercle of the front is a structure which, to my knowledge, does not occur in any other member of the genus. This species bears a curious resemblance to *Hermetia pterocausta* O. S.

***Chrysochlorina albipes* James, n. sp.**

Male. Front and face of equal width, the sides parallel. Head entirely yellow, with moderately abundant blackish pile; the pile just above the antennae, however, is bright yellow, and that of the face has some yellow intermixed; the pile of the front and vertex mostly near the ocular margins, the median stripe being practically bare. First two antennal segments subequal, black-haired; the third segment missing in the type. Thorax yellow; the dorsum with three broad, brown stripes; the median one expands and becomes blackish in front of the scutellum; the lateral ones are narrowly separated from the scutellum, and slightly interrupted at the suture; a brownish spot on the dorsum in front of each wing base. Scutellum brownish at the base. Pleura on each side with a black spot at the middle of the notopleural suture and another above the middle coxa. Pectus brown. Pile of thorax yellow; there is some black, however, on the dorsum, especially posteriorly, and on the basal part of the scutellum. Legs chiefly yellow; the hind coxae, however, are brown, and the hind tibiae and tarsi white. Wings yellowish hyaline, the color heavier toward the costal margin; a spot anterior to the discal cell and the wing apex slightly brown, although the clouding is by no means distinct. Abdomen yellowish on the first three segments, reddish brown on the fourth, and distinctly brown at the apex; a large, indefinitely outlined triangle on each side of the second to fourth segments, at the base, brownish; venter yellow; the third, fourth, and fifth segments brownish in the middle. Length, 12 mm.

Holotype, male, Goyas, Brazil, June, 1938.

(Concluded in Vol. 12, No. 2.)

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CONTENTS OF THIS NUMBER

A NEW GENUS OF SCARABAEIDAE WITH DESCRIPTIONS NOTES ON PHYLLOPHAGA—MILTON W. SANDERSON . . .	1
NEW NEARCTIC PIPUNCULIDAE (DIPTERA)—D. ELMO HARDY	16
FOUR NEW SPECIES OF LEAFHOPPERS AND NOTES ON TWO OTHERS (HOMEOPTERA CICADELLIDAE)—R. H. BEAMER	26
DISTRIBUTION OF THE VEGETABLE WEEVIL IN AR- KANSAS—DWIGHT ISELY	30
UBER ENTOMOLOGISCHE SAMMLUNGEN — WALTER HORN—H. B. HUNGERFORD	31
NOTICE FIFTEENTH ANNUAL MEETING	31
STUDIES IN NEOTROPICAL STRATIOMYIDAE (DIPTERA) —MAURICE T. JAMES	32

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STUDIES IN NEOTROPICAL STRATIOMYIDAE (DIPTERA)

MAURICE T. JAMES
Colorado State College

(Concluded from Vol. 12, No. 1).

II. The genus *Hoplitimyia* James

The genus *Hoplitimyia* was erected by the author (Ann. Ent. Soc. Amer., 27: 443-4, 1934) for the reception of *Stratiomyia constans* Loew and four related species. Johnson, in his monograph of *Stratiomyia*, had previously mentioned the distinctness of this group, but at that time did not consider it wise to propose a generic name for it. The species, so far as known, are wholly American and mostly Neotropical.

Morphologically, this genus is close to *Stratiomys*, but the individuals are wasp-like, rather than bee-like, in appearance. The head is broad, noticeably broader than the thorax, with the eyes produced laterally into somewhat of a cone; the antennae are long and seven-segmented; the first segment is usually at least five times the length of the second (less than that in only one known species), and is somewhat clavate; the third to seventh segments inclusively form a flagellum, which is expanded, usually strap-like, and without a style. The eyes are bare. The occiput is more or less concave; the face is prominent, the antennae being situated on the prominence. The proboscis is of moderate length; the labella, rigid. The scutellum is rounded behind, with two moderately strong spines which are set rather close together, and on the median third of the scutellum. The wings are clouded on the costal region, the line of demarcation between the clouded and the more hyaline areas, however, indefinite; the venation is strong; r-m is usually present; m-cu is long; the three branches of the media extend almost to the posterior margin. The abdomen is typically ovate with the sides of the second to fourth segments approximately parallel; in one species, it is clavate.

Type, *Hoplitimyia* (*Stratiomyia*) *constans* (Loew), by original designation.

The seven known species may be separated by the following key.

Key of species

1. First antennal segment hardly three times the length of the second; abdomen clavate; discal cell small; cross-vein r-m wanting; the branches of the media comparatively weak **clavata**
 First antennal segment five times the length of the second; abdomen ovate; discal cell of normal size; cross-vein r-m distinct; the branches of the media fairly strong 2
2. The second abdominal segment, except sometimes the lateral margins, entirely black 3
 The second abdominal segment with prominent yellow markings 4
3. The fourth and fifth abdominal segments in large part, usually half or more, yellow **mutabilis**
 The fourth segment with a large crescentic yellow band; the abdomen otherwise, except the lateral margin, and sometimes a pair of small spots on the first segment, black **semiluna**
4. Bands on the second segment very narrow, usually entire 5
 Bands on the second segment moderately broad, interrupted 6
5. Body brown; fourth segment margined posteriorly with yellow **vespoides**
 Body black; no yellow on the fourth segment **subalba**
6. Scutellum yellow in both sexes; second segment with an interrupted yellow band **constans**
 Scutellum of male black; second segment with two large yellow spots **bimacula**

Subgenus *Himantomyia* James, nov.

Type, *Hoplitomyia* (*Himantomyia*) **clavata** James, n. sp.

The above species is distinct enough to warrant separate sub-generic consideration; yet its affinities to the typical species of *Hoplitomyia* are too close to permit

generic separation. The first antennal segment is scarcely three times as long as the second; this lower ratio is due, however, not to the shortening of the first, but to the elongation of the second segment, the length of which is twice as great as the maximum width. The occiput is but slightly concave. The wings are slightly narrower than in the typical subgenus, the clouded area being likewise narrower; the discal cell is small, the veins emerging from it, especially the first and third branches of the media, being weakened; cross-vein r-m is wanting. The abdomen is distinctly clavate and widest on the fourth segment.

Hoplitimyia (Himantomyia) clavata James, n. sp.

Male. Head black, marked with yellow as follows: a small triangle in front of and a small subcordate spot behind the ocellar triangle; the lower occipital orbits; a narrow stripe along each eye on the lower part of the face; the lower facial margins; the inner oral margins; and a band extending from the lower facial margin on each side, around the facial depression, to the middle of the outer oral margin. Pile of head brownish, rather thick, about half as long as the first antennal segment; some short black and yellow pile intermixed on the occiput; a tuft of moderately short black pile just anterior to the yellow triangle of the vertex. Eyes briefly contiguous below. Antennae brownish black; the first segment, however, yellow at base and gradually becoming brown. Thorax black, marked with yellow as follows: the humeri; a small spot on each side in front of the suture; the supra-alar regions and a small streak produced from each toward the suture; the broad sides and apex of the scutellum; a band extending from the dorso-pleural suture behind each humerus to the front coxa; a small spot on the upper part of each sternopleuron; a triangle on each mesopleuron in front of the wing base; and a narrow band extending from each wing base to the posterior coxa. Pile long, yellow; in addition, some short, black pile on the dorsum, especially posteriorly on the sides. Legs brownish black; the knees and basal third of each tibia, the basitarsi, and the second segment of the posterior tarsi, yellowish. Halteres blackish. Wings yellowish-hyaline, the clouded areas brown. Abdomen black; on the dorsum, the lateral margin and a small posterior

triangle on each side of the first segment and a more prominent posterior triangle on each side of the second segment are whitish, and the posterior margins of the third, fourth, and fifth segments are yellowish; on the venter, the second segment and the contiguous interrupted apical margin of the first segment are whitish, and the apical margins of the third, fourth, and fifth segments are yellowish. Length, 9.5 mm.

Holotype: male. Banos, Ecuador. Nov. 16, 1937. (S. W. Frost.)

Subgenus **Hoplitimyia** James

The six species which comprise the typical subgenus form a more or less variable complex of closely related species.

Hoplitimyia (Hoplitimyia) mutabilis (Fabricius)

Stratiomys mutabilis Fabricius, Ent. Syst., IV, 266, 1794.

This species was very aptly named, as is indicated by the great amount of variation which occurs within it. The black abdomen, with the apex yellow, will distinguish it from other species. The yellow apex may include the fifth segment, except for its anterior and posterior margins, and the apical half of the fourth segment, or these markings may be somewhat reduced. The scutellum is usually black in the male and yellow with a sub-apical transverse black band in the female, but it may vary to entirely yellow in both sexes. The femora are usually black, with the tibiae and tarsi paler, but variably colored. The abdomen is strongly inflated and, when seen in the right light, silvery pilose above and below, especially in the male, the silvery sheen appearing strongest ventrally.

This is a widely distributed species, and evidently occurs on the mainland throughout tropical America, from Mexico to Argentina. For the United States. I have records from Tucson, Ariz., Oct. 10, 1923; Pima County, Ariz., July 27, 1927 (R. H. Beamer); Donna, Texas, April 10 and Oct. 15, 1933 (J. W. Monk); and Harlington, Texas, April 24, 1931. I have no records of it from the West Indies.

Hoplitimyia (Hoplitimyia) semiluna James, n. sp.

Male. Black, rather copiously clothed with moderately long, white hairs. Head black; a small yellow spot adjacent to each eye on the lower part of the face, and another almost contiguous pair just above the oral margin in the middle; the very narrow lower occipital orbits, extending onto the checks, yellow. Antennae black; the first segment yellow at the base, gradually becoming black. Thorax black; the indefinitely defined apical half of the scutellum, the supra-alar calluses, a large triangle on each mesopleuron, and a smaller one just anterior to the wing base, the upper margins of the sternopleura, and obscure markings on the metapleura, yellow. Femora black; tibiae and tarsi yellowish brown, the apices of the front tibiae and the apical tarsal segments more blackish. Halteres yellow. Wings typical. Abdomen somewhat flattened, black; the very narrow lateral margins of all segments and a prominent crescentic spot on the posterior half of the fourth, yellow; the first ventral segment, the broad lateral margins and middle of the second, and the narrow posterior and lateral margins of the other segments yellow. Abdomen silvery pilose below, but not above. Length, 9.5 mm.

Female. The yellow markings on the head and thorax are much more prominent; the complete occipital, facial, and frontal orbits are yellow; the facial orbits are considerably broadened into a triangular projection inward below the vertex; the occiput is yellow just behind the vertex; there is a complete transverse yellow band above the antennae, and a pair of yellow spots, one to each side of the facial prominence, below the antennae. The first antennal segment is wholly yellow, and the oral margin is somewhat yellowish within. The yellow spots on the pleura are more expanded; on the notum, the humeri and a pair of spots just anterior to the suture and removed from the notopleural suture are yellow; the scutellum is entirely yellow. The second ventral segment is almost wholly black; the first has a black posterior margin.

Holotype, male, Mendoza, Argentina, Oldenburg Collection. In the collection of the Deutsche Entomologische Institut.

Allotype, female, same data.

Paratopotypes, 2 males, 1 female, same data.

This species is closely related to **mutabilis**; it may be distinguished by the lack of yellow markings on the fifth tergite, the lack of silvery pile on the abdominal tergites, and the less robust form. As in **mutabilis**, this species is evidently subject to considerable variation. The legs may be entirely yellowish, the scutellum in the male entirely yellow, and the markings of the thorax, venter, and head may vary in their extent.

Hoplitimyia (Hoplitimyia) vespoides (James)

Stratiomys vespoides James, Jour. Kans. Ent. Soc. 6:67, 1933.

This species is closely related to **sulbalba**, and is probably only a variety of that species. It is distinguished by the brown color, the presence of a complete yellow apex on the fourth segment dorsally, the short brown pile of the abdomen, the great reduction of the silvery ventral areas, and the extensive brown markings of the venter. The silvery pile of the venter is reduced to a large patch on the second segment; the venter is brown, except the first segment and the narrow lateral and posterior margins of the remaining segments. Length, 10 mm.

The type bears the label "Colo., July." No exact locality is given. Type in the Snow Entomological Collection, University of Kansas.

Hoplitimyia (Hoplitimyia) subalba (Walker)

Stratiomys subalba Walker, List, V, 41, 43, 1854.

Stratiomys gerstaeckeri Bellardi, Saggio, I, 31, 1859.

To judge from Walker's description, **Stratiomys subalba** can not be a synonym of **S. mutabilis** Fabricius, as Williston considered it. The synonymy given above is, I believe, correct. In **S. subalba**, the bands on the second and third abdominal segments are interrupted, whereas they are entire in **S. gerstaeckeri**; these bands, however, consist of very narrow posterior margins, and may easily be variable. The abdominal pattern in this species will readily distinguish it from all others except **H. vespoides**. The venter, especially in the males, is densely silvery pilose, and predominantly yellow in ground color.

Type in the British Museum (Natural History).
Distribution, Mexico to Brazil.

Hoplitimyia (Hoplitimyia) constans (Loew)

Stratiomyia constans Loew, Cent., X, 8, 1872.

A black species, handsomely marked with yellow; the thorax has three yellow spots or each side of the dorsum, the first including the humerus, the second just in front of the suture, and the third on the supra-alar callus; in the female, the first two spots on each side may be fused; the notopleural suture is broadly margined with yellow on the pleura, more extensively so in the female; the female usually has an additional spot on each sternopleuron and metapleuron. The head in the female is largely yellow; in the male, it is black with two pairs of yellow spots on the face. Scutellum wholly yellow. Abdomen black, with a pair of yellow spots on the second, third, and fourth segments; these spots are half the length of the segment at least on segment three; on segments three and four of the female, they fuse into a transverse band on the posterior half of each segment. Abdomen silvery above in the male, less so on the venter. Legs yellow. Length, 10 mm.

Type, from Texas, in the Museum of Comparative Zoology, Cambridge, Mass. I have numerous records from Kansas, Oklahoma, and Texas, June to September.

Hoplitimyia (Hoplitimyia) bimacula (Bellardi)

Stratiomys bimacula Bellardi, Saggio, App. 10, 1862.

A moderately large, black species, with a pair of small yellow spots on the face, and small spots on the humeri and supra-alar calluses. The abdomen has a pair of large, translucent yellow spots on the second segment; these occupy all the segment except the anterior and lateral margins, and the narrow longitudinal stripe which lies between them, and separates them. Venter greenish yellow with silvery pile. Legs predominantly dark. Length, 11 mm.

The male type is from Mexico; the female is unknown. I have seen a series of males from Yucatan (G. F. Gaumer, in the Snow Entomological Collection); these agree perfectly with Bellardi's description.

III. The genus **Udamacantha** Enderlein

In 1914, Enderlein proposed the generic name **Udamacantha** for **Stratiomys inermis** Wiedemann, from Argentina. He gave the following generic characters: eyes bare, contiguous in the male for a considerable distance; scutellum very broad and short, somewhat flattened apically, and unspined; tibiae without apical spurs; antennae shorter than the head, the first segment two and one-half times, the second, twice, as long as broad; the flagellum cylindrical, five-segmented, the third antennal segment (the first of the flagellum) two and one-half times, the fourth and fifth each twice, as long as broad; the sixth and seventh together only two-thirds as long as the fifth, the apex rounded; cross-vein m-cu rather long; cross-vein r-m punctiform, or the discal cell lying on the radius; R^2+^3 distal of the cross-vein; R^4 wanting.

To the above generic characters, I should add that the antennae are situated on a definite rounded facial prominence; the proboscis, if straightened, would be almost as long as the height of the head; the labella are slender and rigid; and the three branches of the media are strong, of equal length, and reach almost to the wing margin. In the specimens which I have seen, the antennae are at least as long as the head, and cross-vein r-m is distinctly present, though sometimes very short. This last character seems to be quite variable in this genus and in the closely related **Labostigmina**.

Enderlein referred to **Udamacantha**, in addition to the genotype, **Odontomyia anodonta** Macquart, from South Africa, and **O. exul** Walker, locality unknown. If my identification of **anodonta** is correct, it is a true **Odontomyia**, the spines of which had been broken off, as often happens. Macquart's description otherwise applies perfectly to specimens which I have seen from Southern Rhodesia. I have not identified Walker's species, and it can not be placed on the basis of the description.

Brethes (Ann. Soc. Cient. Argentina, 93: 139, 1933) described **Udamacantha bonariensis** from Buenos Aires, but this species can not belong to this genus, as Brethes describes its ten-segmented antenna in detail.

The number of previously described species that can be referred to this genus is, therefore, only two, with the

possibility that *exul* is not a *Udamacantha*. *Exul* is described as a black species, with the "legs pitchy," the "feet tawny," and the "wings whitish." An additional species is described in this paper.

***Udamacantha protrudens* James, n. sp.**

Female. Head yellow; ocellar triangle black; a large spot in front and to the side of the ocellar triangle, and a small oblique spot on each side of front, adjacent to the eyes, brownish, the color of each spot gradually merging into yellow. Front on upper part prominently raised above the vertex, thence gradually sloping to the facial prominence; facial prominence conspicuous, the antennae almost at its apex. Antennae bright yellow on the first and second segments, the remainder more brownish; the flagellum about half again as long as the two basal segments combined. Head almost bare; some short, scattered black pile on the front and vertex, and some scattered yellow pile of similar length on the face. Proboscis black, yellowish basally. Occiput and occipital orbits yellow. Thorax yellow; the dorsum with three broad black longitudinal vittae; the median one the broadest, and extending from the neck to the base of the scutellum, but tapering behind the suture and touching the scutellum only at a point; the lateral vittae but narrowly separated from the median one, almost attaining the base of the scutellum, where the yellow ground color becomes brownish, but broadly separated from the anterior margin of the dorsum; pectus reddish brown, briefly blackish in the middle. Scutellum wholly yellow. Pile scant, short, yellow. Legs yellow, the tarsi becoming brownish apically; wings hyaline; veins yellow. Abdomen yellow in ground color, but, in actuality, in large part a diffused brownish yellow; the clear yellow areas include all the venter and, on the tergites, the lateral margin, the sides of segment one, large lateral triangles on segments two, three, and four, which reach the base of segment two, and the apex of segment five; these areas are clothed with short, inconspicuous, black hairs which arise from blackened punctures; the abdominal pile is otherwise yellow and inconspicuous. Length, 8 mm.

Male. Vertical triangle and occiput black. Frontal triangle and upper part of face brown; face yellow on lower half; the facial prominence inconspicuous. Pile of front black, of face, yellow. Thorax black, with broad

yellow margins; black of pectus extending broadly onto the mesopleura; scutellum narrowly black at base; pile of thorax much longer than in the female. First abdominal segment black, broadly yellow at the sides; second and third yellow, with a narrow median stripe running from the anterior margin of the second to the posterior margin of the third, and with squarish black spots on the anterior corners of the third; fourth black, with the very narrow lateral margins and a small rectangular spot at each posterior corner yellow; fifth black; with the lateral and apical margins yellow; venter wholly yellow. Otherwise, except sexually, as in the female.

Holotype: female, Cordoba, Argentina (Davis) In the Museum of Comparative Zoology, Cambridge, Mass.

Allotopotype: male, same data.

Paratopotype: female, same data.

Also a male and female, same data, in a somewhat teneral condition.

Udamacantha inermis (Wiedemann)

Stratiomys inermis Wiedemann, Aus. Eur. Zw. Ins., II, 71, 18, 1830.

The female, according to specimens from Mendoza, Argentina (Deutsche Entomologische Institut), differs from **protrudens** as follows. The vertex is largely black, the posterior margins and ocular orbits, however, being yellow; the front is marked by a black bar over the antennae and by three spots above, one touching each eye, and a geminate middle spot, sometimes twice connected to the black of the vertex. The front is not so prominent above, nor is the facial prominence so conspicuous. The thoracic dorsum may be described as black, with broad yellow lateral margins and with a pair of median yellow vittae which may extend almost from the anterior margin almost to the base of the scutellum; the scutellum, as in **protrudens**, is wholly yellow. The abdomen is black, with broad yellow margins on segments two to five and a broad apical margin on five; segments two, three, and four each bear a pair of conspicuous yellow spots on the disc.

The extent of the markings on the head and thorax is subject to some variation. Wiedemann does not mention the median stripes on the thorax, though otherwise his description agrees with mine. The male, according to Wiedemann, has the yellow abdominal spots connected or almost so.

NEW AND LITTLE KNOWN PHYLLOPHAGA FROM TEXAS, (SCARABAEIDAE, COLEOPTERA)¹

H. J. REINHARD, College Station, Texas.

Among the species of **Phyllophaga** described in this paper are included certain forms that are of considerable interest because of their economic importance. Names for these are required in investigations being conducted on their biology and control. Types of the new species described below are in the Texas Agricultural Experiment Station collection. Brief notes are included on several little known species previously described from the State.

I am under obligations to my colleagues who collected most of the new forms as indicated under the descriptions. To Dr. E. A. Chapin, Messrs. H. C. Fall and M. W. Sanderson acknowledgment is made for helpful assistance in comparing certain species with types in their charge or other material in their personal collections.

***Phyllophaga rubricosa*, n. sp.**

(Plate 1)

Form variable in the sexes, reddish brown, surface above alutaceous and feebly shining. Clypeus concave, vaguely emarginate, moderately reflexed, coarsely, deeply punctured; suture subangulate. Front convex, punctures slightly coarser than on clypeus. Antennae with ten segments. Thorax obtusely angulate at middle, narrowed at base and apex, margin usually crenulate but sometimes nearly entire; punctures moderately coarse, not dense, irregularly spaced, each bearing a short decumbent hair. Mesosternum closely punctate, beset with sparse, short pale hairs. Prosternal process projecting downward at sides, prominent. Legs shining reddish brown; tooth of claw always well developed, acute, intramedian. Scutellum wider than long, with moderately coarse, deep punctures on apex and sides. Elytra more evenly, finely punctured than thorax, each puncture bearing a minute hair, not conspicuous; sutural costae feebly elevated but distinct, discal and submarginal costae almost entirely obliterated. Abdomen feebly shining, sides finely, not closely punctate, clothed with sparse, short

¹ Contribution No. 495 from the Division of Entomology, Texas Agricultural Experiment Station, Agricultural and Mechanical College of Texas.

hairs. Pygidium wider than long, surface translucent, with scattered, vague punctures, apical margin ciliate.

Length, 12-15 mm.; width, 6-8 mm.

Male.—Oblong, nearly parallel, body winged. Antennal club pale yellow, almost equal length of funicle. Abdomen slightly flattened at middle; fifth ventral segment simple; sixth segment very short, with a vague median transverse impression, hind margin entire, ciliate. Hind tibiae obliquely truncate; spurs moveable, slender, obtuse, inner subequal and outer three-fourths the length of first hind tarsal segment. Hind tarsi moderately stout, longer than tibiae.

Female.—Body ovate, ventricose, apterous. Antennal club distinctly shorter than funicle. Abdomen evenly convex at middle; fifth ventral segment slightly depressed on apical third and somewhat flattened at sides; sixth segment about half the length of preceding, hardly depressed at middle, apex entire. Hind tarsi distinctly shorter than tibiae. Tooth of claw longer and more nearly median than in male.

Holotype male and Allotype female, Dimmit County, Texas, March 13, 1938 (M. J. James). Paratypes: 224 males and 14 females, Dimmit and Zavala Counties, Texas, March-April, 1933-38 (S. E. Jones, M. J. Janes, T. B. Randolph); 1 male, Wharton, Texas, March 16, 1932 (S. E. McGregor); and 2 males Pleasanton, Texas, March 10, 1933 (C. E. Heard).

Related to *epigaea*, an almost wholly black species, which differs structurally in having shorter hind tibial spurs, prosternal process poorly developed, and tooth of claw small or obsolete in the male sex. There are also differences in sculpturation. It may be mentioned that *epigaea* has been collected most commonly during the day time, while *rubricosa* is generally inactive until shortly after dark. All males of the type series were taken either in light traps or under street lights in company with the females.

***Phyllophaga renodis*, n. sp.**

(Plate 1)

Body apterous, ovate, convex, deep reddish brown with head and thorax darker, surface above alutaceous, feebly shining. Clypeus concave, nearly entire, moderately reflexed, coarsely, deeply punctate; suture sinuate. Front convex, surface closely, more coarsely punctured

than clypeus. Antennae with ten segments. Thorax convex with median area in front noticeably flattened, sides strongly angulate, base slightly narrower than apex, lateral margin crenulate; punctures coarse, not dense, irregularly spaced leaving smooth intervening areas on disc and near sides. Mesosternum rather coarsely, not closely punctate, sparsely clothed with short pale hairs. Legs shining brown, tarsi paler or reddish; tooth of claw strong, acute, intramedian, scutellum short, transverse, smooth or indistinctly punctured. Elytra strongly convex, humeral angles depressed and basal margin slightly reflexed; surface more finely and evenly punctate than thorax; sutural costae not very distinct, the discal and submarginal ones wholly obliterated. Abdomen somewhat shiny; sides with scattered but well impressed punctures and sparse pale hairs. Pygidium alutaceous, with coarse, shallow, sparsely placed punctures, apical margin reflexed, ciliate.

Length, 16 mm.; width 9 mm.

Male.—Antennal club shorter than funicle. Abdomen broadly flattened at middle; fifth ventral segment with a vague transverse ridge at middle; sixth segment short, with a shallow transverse median groove. apex entire, ciliate. Front tibiae tridentate, the tarsi with a small incurved tooth at inner apex of segments one to three. Hind tibial spurs free, slender, obtuse, inner about three-fourths and the outer three-fifths length of first hind tarsal segment. Hind tarsi rather stout, about as long as the tibiae.

Female.—Unknown.

Holotype: Fowlerton, Texas, March 23, 1938, taken while crawling on ground at midday by C. E. Heard.

The species resembles *cribrosa* in general appearance, but is readily distinguished by its smaller size, smoother, or non-costate elytra, red color, etc. There are also structural differences in the genitalia.

***Phyllophaga plena*, n. sp.**

(Plate 1)

Form variable in the sexes, castaneous to piceous, glabrous above, subshining. Clypeus subconvex, broadly vaguely emarginate, moderately reflexed; punctures moderately coarse, dense, not deeply impressed; suture subangulate. Front convex, punctures close but slightly

coarser and deeper than on clypeus. Antennae with ten segments. Thorax widest at middle, apex narrower than base, sides crenulate, ciliate; surface rather finely punctate, the punctures moderately close on disc becoming much sparser at the sides. Legs reddish brown; fore tibiae tridentate, their tarsi with a tooth at inner apical extremity of segments one to four. Scutellum broader than long, with well impressed punctures at sides, median line usually smooth. Elytra rugulose, punctures fine, sparse and indistinct; sutural costae broad, well marked, the discal and submarginal costae scarcely visible. Abdomen moderately shining, rather sparsely, finely punctate, each puncture bearing a short hair, segments five and six more coarsely punctate with some longer hairs at sides. Pygidium moderately shining, rather finely, sparsely punctate, more convex and transverse in male.

Length, 19-24 mm.; width, 10-13 mm.

Male.—Form rather depressed, elongate, subparallel, castaneous, body winged. Antennal club yellow, equal or a trifle longer than stem. Mesosternum finely, closely punctate, clothed with dense, long, silky, yellowish hairs. Abdomen broadly impressed at middle; fifth ventral segment simple, surface finely scabrous beyond the narrow, polished basal margin; sixth segment about one-half the length of fifth, impressed at middle from base to apex, latter entire. Hind tibiae obliquely truncate; spurs moveable, long, broad, slightly curved, obtuse, outer about three-fourth as long as inner. Hind tarsi very distinctly longer than tibiae. Tooth of claw moderately long, intramedian.

Female.—Body robust, convex, ovate, dilated behind, piceous; elytra more or less fused along sutural margin, wings about normal in size but apparently non-functional. Antennal club reddish yellow, shorter than funicle. Mesosternum more coarsely punctate than in male, clothed with sparse, short, decumbent, pale hairs. Abdomen vaguely flattened at middle; apical ventral segment convex, coarsely, deeply punctured, shorter than preceding segment, hind margin entire. Legs stout, hind tarsi subequal the length of tibiae. Tooth of claw longer and more acute than in male.

Holotype male and Allotype female, San Patricio County, Texas, March 11, 1938 (T. M. Carson). Paratypes: 81 males and 319 females, same data as type; 4 males, and 1 female, Odem, Texas, February 18, 1938 (H.

Mecom) ; 14 males and 14 females, Nueces County, Texas, March 29-31, 1938 (C. E. Marcum).

The species is perhaps nearest *farcta* in relationship but may be distinguished at once by the non-gibbous pygidium, genital characters, coloration, and longer antennal club in male. There are additional minor differences.

***Phyllophaga hamata* Horn**

(Plate 1)

***Lachnosterna hamata* Horn**, Trans. Am. Ent. Soc., Vol. 14, 1887, p. 220.

Described from a unique male specimen from Texas, without precise locality. Several male specimens taken at San Angelo, Texas, June 14, 1932, by S. E. Jones check closely with the original description. Additional material includes: one male, Menard, Texas, June 10, 1932 (H. E. Parish) ; and two females, Sonora, Texas, June 3, 1938 (C. E. Heard).

The species is less robust in build than *torta*, to which it appears closely related. The genitalic characters in the female sex of the two species are quite similar, but the males are at once distinguished by wide differences in the structure of the genital claspers.

***Phyllophaga ephilida virilis*, n. subsp.**

(Plate 1)

Similar to the typical form but readily distinguished in the male sex by the genital characters as illustrated.

Body slightly elongate, subcylindrical, moderately shining, rufocastaneous. Clypeus broadly reflexed, feebly emarginate, rather finely, closely punctured; suture strongly sinuate. Front subconvex, punctures denser, slightly coarser than on clypeus. Antennae with ten segments. Thorax widest at middle, sides arcuate, entire, punctures hardly coarser but distinctly sparser than on front. Mesosternum evenly punctate, sparsely clothed with rather short pale hairs. Tooth of claw strong, acute, intramedian. Elytra finely, not closely punctate; discal costae narrow, feeble, the sutural well defined. Abdomen shiny, sides sparsely, finely punctate, venter smoother. Pygidium moderately transverse, surface uneven, with large, vague punctures becoming more apparent near the sides.

Length, 15-17 mm.; width, 7-8 mm.

Male.—Antennal club shorter than stem. Abdomen somewhat flattened at middle; fifth ventral segment with a roughened semicircular depression on apical half, hind edge broadly, not deeply emarginate; sixth segment deeply impressed and roughened at middle, apex broadly, deeply emarginate. Hind tibia obliquely truncate; inner spur moderately long, lanceolate, subacute; outer spur fixed, obtuse, hardly one-third length of inner.

Female.—Specimens taken in company, but none in coitu, with the above described males, show no tangible characters to distinguish them from typical *ephilida* females.

Holotype male, Dickinson, Texas, June 30, 1931 (J. N. Roney). Paratypes: 4 males, same data as type, and 1 male, Dickinson, Texas, May, 1929 (F. M. Hull).

***Phyllophaga sacoma*, n. sp.**

(Plate 1)

Oblong, slightly widened behind, reddish brown, surface pruinose. Clypeus concave, feebly emarginate, moderately reflexed; punctures moderately coarse, well impressed, not very close; suture sinuous. Front somewhat flattened, surface a little more coarsely punctured than clypeus. Antennae with ten segments. Thorax irregularly convex, widest slightly before middle, sides arcuate, margin entire except near basal angles; surface with moderate punctures, rather sparsely and irregularly placed, median line usually impunctate. Mesosternum pruinose, finely, densely punctured, thickly clothed with longish, silky, yellow hairs. Legs reddish, shining; tooth of claws strong, acute, median. Elytra more finely punctate than thorax, the punctures not dense and each bearing a very minute, pale, decumbent hair; sutural costae broad and distinct, discal and submarginal costae slightly elevated and visible to posthumeral region. Pygidium transverse, puncturation moderately dense at base, apex smoother, shiny, lateral and basal margins pruinose. Abdomen finely, sparsely punctate, beset with short, pale hairs, surface pruinose except on venter.

Length, 15-17 mm.; width, 7.5-9 mm.

Male.—Antennal club shorter than stem. Abdomen broadly flattened at middle; fifth ventral segment with a feeble arcuate ridge near middle; sixth segment irregularly concave, with apical margin broadly emarginate.

Hind tibiae obliquely truncate; inner spur long, lanceolate, slightly curved, obtuse; outer spur fixed, narrower, about half the length of inner. Hind tarsi slightly exceeding the length of tibiae.

Female.—Antennal club shorter than funicle. Abdomen vaguely flattened at middle; fifth ventral segment slightly depressed before hind margin, flattened and pruinose at sides, bearing a few long, erect, fine hairs; sixth segment feebly concave at middle, with narrow basal margin at sides slightly elevated, apical margin rather deeply and broadly emarginate. Hind tarsi hardly as long as tibiae. Hind tibial spurs broader and more obtuse than in male.

Holotype male and Allotype female, Smith County, Texas, April 30, 1937, (H. J. Reinhard and W. L. Owen, Jr.). Paratypes: 45 males and 5 females, same data as types; 20 males, Smith County, Texas, March-May, 1937 (W. L. Owen, Jr.); 2 males, Hearne, Texas, April 4, 1929 (F. F. Bibby); 1 male, Arp, Texas, April 27, 1917, without collector's label; 5 males, Prescott, Arkansas, May 4, 1932 (Mrs. S. E. McGregor). In the U. S. National Museum, 17 males from New Waverly, Texas, April 4, 1935 (W. H. Kellogg), and 1 male, Conroe, Texas, April 19, 1936 (H. A. Budde).

Without reference to the genitalia the present species might easily be confused with *micans*. There are seemingly no other important structural differences. The ground color of *sacoma* is apparently paler or more reddish than in typical *micans* or in *micans cupuliformis*.

***Phyllophaga scitula* Horn.**

(Plate 2)

***Lachnosterna scitula* Horn**, Trans. Am. Ent. Soc., Vol. 14, 1887, p. 256.

This fine species was also described from Texas without mention of any specific type locality. With the lapse of a half century no additional material appears to have been mentioned in literature. Three specimens taken by me at Bryan, Texas, April 16 and 23, 1934, trace readily to the present species in Horn's keys (loc. cit.). No additional material was accumulated until the species was discovered as not uncommon in Smith County, Texas, during April, 1937. Collections at that

time indicate that pecan is one of the preferred food plants.

The peculiar coloration and distinctive thoracic sculpturing make the species readily recognizable. It is also distinguished from allied forms by the genitalia. The latter show slight variations in structure in the male sex; the average condition appearing about as illustrated (Plate 2).

***Phyllophaga curialis*, n. sp.**

(Plate 2)

Form oblong, oval, wider behind, dark brown to piceous, apparently glabrous above, surface moderately shining. Clypeus flattened, rather deeply emarginate, narrowly reflexed; punctures moderately coarse, dense, well impressed; suture feebly sinuate. Front subconvex, punctures closely placed as on clypeus but a little coarser. Antennae with ten segments. Thorax widest at middle, sides obtusely angulate, slightly narrowed to base and more obliquely convergent in front, margin entire; punctures setiferous, distinctly coarser than on front, rather sparse and irregularly spaced, setae of punctures near lateral margin longer but decumbent as on disc. Mesosternum densely punctate, hairs yellow, moderately long and dense. Legs shining red; tooth of claw stout, long, acute, median. Elytra rugulose, finely not closely punctate; sutural costae well marked, first discal broad behind gradually narrowed anteriorly and obsolete before base, submarginal costae narrow, not defined on basal half. Pygidium convex, transverse, rather finely, sparsely punctate, apical margin ciliate. Abdomen feebly shining, sides sparsely, finely punctate, clothed with short, pale hairs, last two segments more coarsely punctate.

Length, 19 mm.; width, 10 mm.

Male.—Antennal club shorter than stem. Abdomen broadly flattened and slightly concave at middle; fifth ventral segment with a feebly elevated arcuate ridge, not reaching hind margin at sides; sixth segment rather deeply concave at middle from base to apex; latter abruptly, not deeply emarginate. Hind tibiae obliquely truncate; inner spur long, lanceolate, obtuse; outer spur fixed, rather broad, slightly twisted and decurved, about two-thirds length of inner.

Female.—Unknown.

Holotype: Liberty, Texas, April 6, 1934 (S. E. McGregor).

Allied to **profunda** but readily distinguished by the less robust build; finer, sparser thoracic puncturation; and in the structure of the male genital claspers.

***Phyllophaga pudorosa*, n. sp.**

(Plate 2)

Body elongate, subparallel, castaneous to piceous, head and thorax more shining, surface of latter and elytra with sparse vestiture of both long and short pale hairs. Clypeus flat, deeply emarginate, narrowly reflexed; punctures dense, moderately coarse, well impressed; suture slightly sinuate. Front subconvex, punctures closely spaced, somewhat coarser than on clypeus. Antennae with ten segments. Thorax short, widest at middle, sides arcuate, slightly narrowed to base, more obliquely in front, margin entire; punctures as on front but but much sparser and irregularly placed, hairs near lateral margin considerably longer but decumbent. Mesosternum closely punctate, hairs pale yellow, moderately long not very dense. Legs wholly reddish; tooth of claw long, acute, median. Elytra rugulose, subopaque, sparsely beset with longish suberect and shorter decumbent hairs, punctures finer than on thorax, not deeply impressed and rather indistinct; sutural costae strong, considerably narrowed before anterior extremity, first discal and submarginal costae but slightly elevated and vaguely defined. Pygidium transverse, subshining, sparsely to moderately punctate, apical margin ciliate. Abdomen feebly shiny, sides finely, not densely punctate, each puncture bearing a short hair, segments five and six more coarsely punctate.

Length, 17-18 mm.; width, 7.5-9 mm.

Male.—Antennal club slightly shorter than stem. Abdomen flattened at middle; fifth ventral segment with a feebly elevated roughened arcuate ridge, sometimes barely defined; sixth segment rather broadly depressed at middle, apex abruptly, not deeply emarginate. Hind tibiae obliquely truncate; outer spur fixed, moderately wide, subacute; inner spur lanceolate, slightly curved, obtuse, nearly twice as long as outer.

Female.—Unknown.

Holotype male, Daingerfield, Texas, June 24, 1937, State Park Survey. Paratypes: 1 male, same data as type; 2 males, Shreveport, Louisiana, May 18 and 25, 1937, (W. C. Pierce), in the U. S. National Museum.

The species traces to *hirticula* and *delata* in Horn's keys, but differs from both in the structure of the male genital claspers. In the present species the thoracic punctures are much finer than in *hirticula*, and the hairs on the elytra are noticeably sparser and longer than in *delata*.

Phyllophaga opacita, n. sp.

(Plate 2)

Body oblong, subcylindrical, ferrugineous head sometimes slightly infuscated, surface subopaque, uniformly clothed with fine, short, depressed, pale hairs. Clypeus subshining, shallowly emarginate, narrowly reflexed, punctures moderately coarse, closely spaced, well impressed; suture sinuous. Front convex, more finely and densely punctured than clypeus. Antennae composed of ten segments. Thorax above rather evenly convex but with a vague depression at middle near either side, latter arcuate, margin entire; punctures very fine, feebly impressed, closely, evenly spaced, with each bearing a short hair. Mesosternum moderately, finely punctate, hairs rather short, not dense. Legs reddish; front tibiae tridentate; tooth of claws long, acute, median. Elytra with punctures as on thorax; sutural costae strong, first discal costae barely elevated, poorly defined, submarginal costae narrow but distinct. Abdomen more shiny than above, finely, not closely punctured, clothed with short depressed hairs with some longer and erect on last two segments. Pygidium finely punctate, subshining, clothed with short hairs.

Length, 14.5-16 mm.; width, 6-7.5 mm.

Male.—Antennal club yellow, slightly shorter than stem. Abdomen not noticeably flattened at middle; fifth ventral segment with a submedian, transverse, granular carina, broadly divided at middle and declivous posteriorly; sixth segment about half as long as preceding, flattened or vaguely impressed at middle, apex entire. Hind tibia about equal the combined length of its four proximal tarsal segment; spurs moveable, slender, acute, slightly decurved, inner one a trifle longer than outer.

Female.—Antennae wholly reddish, club shorter than funicle. Abdomen evenly convex at middle; fifth

ventral segment simple, plane in profile gradually sloping to hind margin; sixth segment flat or almost so at middle, more coarsely punctate than fifth and only about one-half as long, apex entire. Hind tarsi about equal the length of tibiae. Hind tibial spurs obtuse and much broader than in male.

Holotype male and Allotype female, Bastrop, Texas, July 15, 1937, State Park Survey. Paratypes: 1 male, same data as type; and 4 females, from same locality, July 27-31, 1937.

The present species checks closely with Horn's description of *arcta* (Trans. Am. Ent. Soc., Vol. 14, pp. 271-2). The original type series of *arcta* (not seen by me) included two female specimens from some unknown locality in Texas. In the presence of a second closely related form it might seem impossible to decide which one is to be taken as the true *arcta*. It may provisionally be assumed that the common East Texas form will prove identical with *arcta* and its counterpart, a much less common form from Southwest Texas, represents a new species as described above. The two species differ most essentially in genital characters as illustrated (Plate 2).

Phyllophaga tristis (Fabricius)

Melolontha tristis Fabricius, Species Ins., 1, 1781, p. 39.

Texas specimens which trace to the present species in all available keys show variations not only in sculpture, size, and coloration, but also in some of the secondary sexual characters commonly employed to distinguish forms of specific rank. The male genital claspers are practically the same throughout the series, but there are seemingly important differences in the structure or shape of the apical process of the internal genital sac that may be used to distinguish restricted forms within this complex.

Tristis was originally described in 1781 from "Boreal America." The type specimens probably came from the northeastern section of the United States, and it may be assumed that the common form of that region agrees most closely with the type series. Accordingly, this common northeastern form considered as *tristis tristis*, without examination of the type, may be characterized as follows:

Body oblong, slightly widened behind, testaceous, with sparse vestiture of pale hairs, latter long and erect on head and thorax, shorter and suberect on elytra.

Clypeus concave, entire, moderately coarsely, not densely punctate. Front convex, coarsely, closely punctate. Antennae with ten segments. Thorax moderately shining, coarsely, rather closely punctate, sides angulate, margin entire except sometimes near base, anterior angles distinct but not produced. Mesosternum densely, finely punctured, hairs thick, long, pale yellow. Legs reddish, shining; hind tarsus about equal length of tibia. Elytra moderately shiny, punctures well impressed, finer than on thorax but not dense; submarginal and discal costae not defined, sutural feebly elevated but distinct. Pygidium vertical, transverse, subshining; rather coarsely closely punctate, clothed with intermixed short and longish hairs, latter erect. Abdomen moderately shining, sides rather finely, sparsely punctate, hairs short, extending on venter.

Length, 12-14 mm.; width, 6-7.5 mm.

Male.—Antennal club subequal length of stem. Abdomen flattened at middle; fifth ventral segment with a short, transverse, almost acute ridge near anterior margin, impressed and roughened at middle, hind margin abruptly emarginate; sixth segment transversely elevated on narrow basal margin, apex entire. Internal genital sac with the apical process moderately protruding, subulate, only slightly bowed as viewed from side. Spurs of hind tibiae moveable, slender, obtuse, inner one longer than first hind tarsal segment. Tooth of claws rather small, acute, intramedian.

Female.—Antennal club slightly shorter than funicle. Abdomen vaguely impressed at middle; apical segment convex, apex entire. Tooth of claw longer and more nearly median than in male.

This form extends from the Northeast Atlantic seaboard westward to British Columbia and southward to Georgia. It is not represented in the present available Texas material.

***Phyllophaga tristis apicata*, n. subsp.**

Similar to typical form except as follows: Size smaller, rufotestaceous, surface more shining in both sexes. Male antennal club usually distinctly shorter than stem. Abdomen rather broadly flattened at middle; fifth ventral segment with a feebly elevated, transverse, roughened ridge at middle near front border. Internal genital sac bearing a rather short, thick apical process, narrowed

outwardly in profile to a slightly emarginate apex with the anterior extremity angularly produced as a short, acute tooth.

Length, 10-12 mm.; width 5-6 mm.

Holotype male and Allotype female, College Station, Texas, April 30, 1930 (H. J. Reinhard). Paratypes: Five males and 10 females, same data as type; 2 males and 1 female, Smith County, Texas, April 21 and 30, 1937 (W. L. Owen, Jr.); 1 female, Atlanta, Texas, April 25, 1925, without collector's label; 4 males and 2 females, Tonganoxie, Kansas, State Lake, April 29, 1933 (M. W. Sander-son); 2 males, Cody's Gap, Arkansas, April (Archer); 1 male, Mobile, Alabama, March 15, 1913 (H. P. Lod-ing); 1 male labeled "Auburn, Alabama"; 3 males and 2 females, Zebulon, Perry and Rome, Georgia, April 1937-38, all collected by P. W. Fattig; 9 males and 1 female, Walhalla, Chappells and Florence, South Carolina, February 19, 1931, and March 17, 1929 (O. L. Cartwright) and April 20, 1937 (J. G. Watts). 1 male, Paducah, Kentucky, May 6, 1937 (Paul Ritcher); 1 male, Washington, D. C., April 23, (H. S. Barber); and 1 male, Takoma Park, Maryland, April 29, 1933, without collector's label.

***Phyllophaga tristis suttonana*, n. subsp.**

With the essential characters of *tristis tristis*, except: Rufotestaceous in color, surface more shining in both sexes. Front more coarsely, cribrately punctured; anterior thoracic angles acute, somewhat produced; ventral carina of abdomen in male a little more prominent than in preceding form. Apical process of internal genital sac elongate, somewhat flattened beyond basal curvature, but narrow and gradually tapering toward tip, which bears a pale semitransparent membrane. Hind tibial spurs moderately broad, inner one subequal the length of first hind tarsal segment.

Length, 12-14 mm.; width, 6-7 mm.

Holotype male and Allotype female, Sonora, Texas, April 14, 1932 (S. E. Jones). Paratypes: Four males and 6 females, same data as type; and 2 males, San Angelo, Texas, April 5, 1932 (S. E. Jones).

***Phyllophaga tristis amplicornis*, n. subsp.**

Similar to *tristis tristis* in all respects except: Less robust in build, elytra flavotestaceous, head and thorax

more finely punctate, eyes distinctly larger and more prominent. Male antennal club equal or longer than stem, usually somewhat bowed near apex. Fifth ventral segment of abdomen with a long thin or blade-like transverse ridge near anterior margin, flattened or vaguely impressed at middle, hind edge deeply emarginate; sixth segment short, transversely impressed at middle, apex slightly notched. Apical process of internal genital sac strikingly flattened on distal part, lanceolate to spatulate in outline as viewed from behind, the margin pale and semitransparent. Tooth of claw in female intramedian as in male.

Length, 10.5-14 mm.; width, 5-7 mm.

Holotype male and Allotype female, Stephenville, Texas, April 28, 1937 (N. Randolph). Paratypes: Sixty-four males and 28 females, Stephenville, Texas, March 25 to May 7, 1938-39 (N. Randolph); 6 males and 1 female, Smith County, Texas, April-May 1937-38 (W. L. Owen, Jr., and H. J. Reinhard); 4 males, Bexar County, Texas, March-April, 1929 (H. B. Parks); 1 male and 1 female, Pleasanton, Texas, February, 1934, and March, 1938 (C. E. Heard); 2 females, Cameron, Texas, April 28, 1938 (M. J. Janes). In the University of Kansas Collection, 2 males, Colorado County, Texas, April 7, 1922, "U. of K. Lot 1116"; and in the Field Museum of Natural History Collection, 2 females labeled "Texas" without date or collector's label.

Phyllophaga tusa Horn

(Plate 2)

Lachnosterna tusa Horn, Trans. Am. Ent. Soc., Vol. 14, 1887, pp. 290-291.

This interesting little species was originally characterized from nine male specimens collected near San Antonio, Texas, by F. S. Aaron. Although the species does not appear uncommon, no other mention of it seems to have been made in literature. A total of 82 male specimens were taken by S. E. Jones and M. J. Janes at Winter Haven, Texas, in light trap collections extending from April to July. The female sex is not known.

The bidentate anterior tibiae, long antennal club, peculiar ventral carina, and genitalia in the male are distinctive characters, which at once distinguish the species from all related known forms in Texas. It may be point-

ed out that the piceous thoracic spot mentioned by Horn is frequently absent, and in such cases the pale coloration of the upper surface contrasts sharply with the wholly black head. No food plants have been recorded for the species.

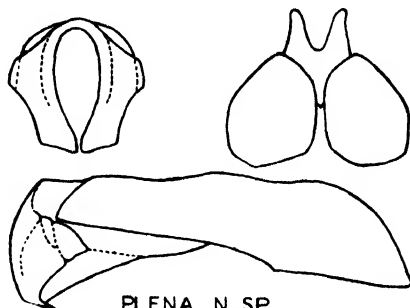
Explanation of Plates

The diagrammatic sketches of the male and female genitalia are all drawn to the same scale. Illustrations for each species include a hind view of the male claspers, beneath which is shown a right lateral view or left and right lateral views of the same. Sketches of the female genitalia in six species are shown in ventral view at the upper right, except in **scitula**, where the upper left and right figures represent a ventral and a right lateral view, respectively.

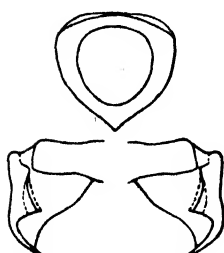
Plate I



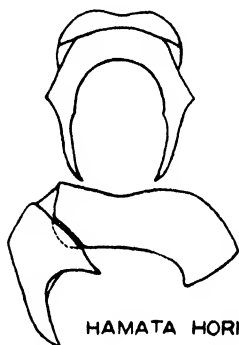
RUBRICOSA, N. SP.



PLENA, N. SP.



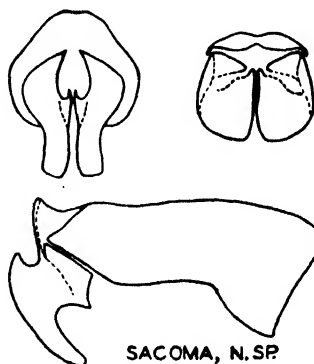
RENODIS, N. SP.



HAMATA HORN



EPHILIDA VIRILIS, N. SUBSP.

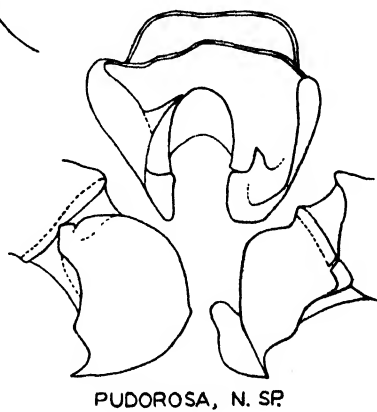
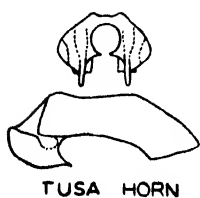
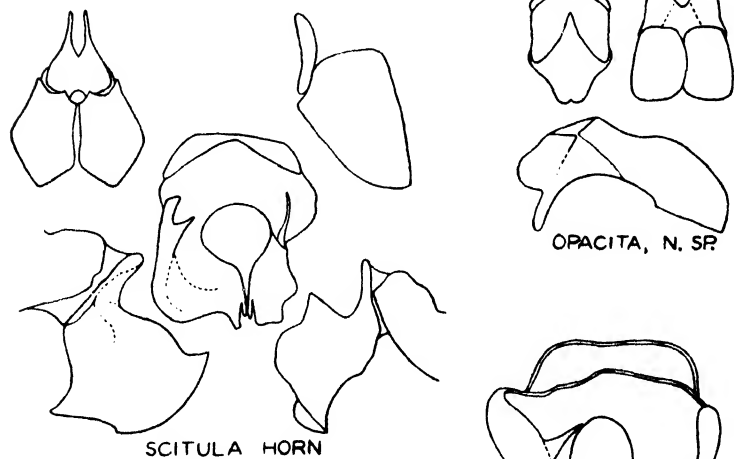
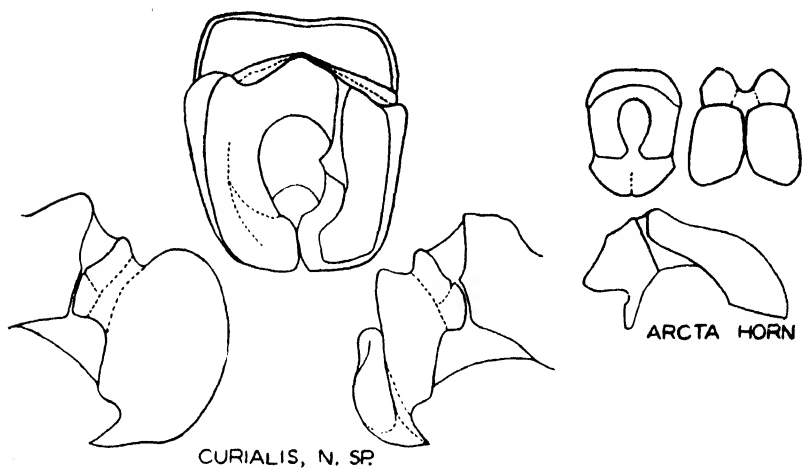


SACOMA, N. SP.



EPHILIDA SAY

Plate II



OBSERVATION ON WHITE GRUB PUPATION *

P. O. RITCHER,

Kentucky Agricultural Experiment Station, Lexington.

A survey of the North American literature on white grubs (Phyllophaga) shows that workers in several states and Canada have made statements regarding depths of pupation. However, in most cases, even when a definite statement is made, the species of Phyllophaga involved are not named and no attempt is made to distinguish between the pupation habits of the various species.

Forbes (1891) of Illinois states that white grubs pupate a few inches underground. Forbes (1907) infers that Phyllophaga grubs pupate from two or three to five or six inches below the surface of the soil. Criddle (1918) states that four species, *Ph. anxia*, *drakii*, *nitida*, and *rugosa* occur in Manitoba and that the average depth at which all stages of Phyllophaga are found in summer is four inches. Davis (1918, revised by Davis in 1929) and Luginbill (1938) present a life cycle chart showing a white grub pupating at or above the plow line. According to Sweetman (1927) larvae of Minnesota May beetles pupate in the soil from a few inches to two feet deep. Hayes (1928) presents records on hibernation depths for adults of certain species of Phyllophaga occurring in Kansas and states that for some species these are the same as the depths at which the grubs pupated.

Drake, Travis, and Collins (1933) present a graph of the distribution of hibernating adults (in pupal cells) for 169 May beetles dug from the soil in an Iowa pasture. The mean depth was 11.47 inches and the depth of pupation ranged from 3 to 17 inches. Ritcher and Fluke (1935) state that 213 Phyllophaga prepupae and pupae were found at an average depth of 16.2 inches at Argyle, Wisconsin. Although not mentioned in this paper, most of these prepupae and pupae belonged to the species *Ph. hirticula* which is dominant in that vicinity. Chamberlin et al (1938) state that most Phyllophaga pupae are found below 10 inches in the soil.

It is apparent from the above statements that there is considerable contradiction in the literature. The

* The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

writer believes that the contradiction arises from three sources. In the first place, the larvae of some species of *Phyllophaga* pupate deep in the soil while others do not, even when present in the same soil. Since over 125 species of *Phyllophaga* occur in the United States and since the species of importance in any given area are often entirely different from those of other areas, writers making general statements concerning pupation often based their conclusions on different species complexes. In the second place, the depth of pupation for a given species of *Phyllophaga* may differ in different types of soil. Grubs do not go as deep to pupate in heavy clay as they do in silt loam soils. Drainage and soil moisture are also factors influencing pupation. In the third place, without doubt, some workers did not examine the soil to a sufficient depth.

Data on the pupation depths of several species of *Phyllophaga* was gathered in eastern Kentucky in 1936, 1938, and 1939. (Tables 1 and 2). Every record given is for a definite species of *Phyllophaga* in a definite soil type and each record was substantiated either by the finding of a prepupa or pupa which was reared to the adult stage or by locating the larval and pupal exuviae after an adult was found. Although the writer observed that *Phyllophaga* adults in most cases hibernate in their pupal cells, he has omitted all records where only the adult was found. Except in Area C, which will be mentioned later, every digging was made to the depth of at least 24 inches if soil conditions permitted.

Description of Areas Sampled¹

Area A was fallow ground with a cover of annual grasses, ragweed, and smartweed. The soil type was Hagerstown silt loam which is one of the fertile soils of the Inner Bluegrass Region and similar to the Maury silt loams in structure. The area sampled was about half-way up an east slope in rolling country two miles southwest of Lexington. Area B was in a permanent bluegrass pasture. The soil type was Maury silt loam which is the

1. The writer is indebted to Martin E. Weeks for the identification of soil types.

TABLE 1. Pupation depths of *Phyllophaga hirticula*, *inversa*, *bipartita*, and *futilis* in several Kentucky soils.

No.	Place	<i>Ph. hirticula</i>			<i>Ph. inversa</i>			<i>Ph. bipartita</i>			<i>Ph. futilis</i>		
		No.	Min.	Max.	Mean	No.	Min.	Max.	Mean	No.	Min.	Max.	Mean
A	Lexington	118	7.5in.	23in.	15.6in.	5	5in.	8in	6.6in.	1	7in.	7in.	7in.
B	Lexington	44	7in.	18.5in.	13.3in.	4	5.5in	8.5in.	6.9in.				
BA	Lexington	3	9in.	11in.	10in.					2	4in.	8in.	6in.
C	Lexington	2	9in.	15.5in.	12.2in.	1	5in.	5in.	5in.				
D	Minorsville	2	10in.	17.5in.	13.8in.	20	3in.	7.5in	4.7in.	47	3in.	12.5in	8in.

TABLE 2. Depths of pupation of *Phyllophaga fusca*, *fraterna*, *tristis*, and *kentuckiana* in several Kentucky soils.

No.	Place	<i>Ph. fusca</i>			<i>Ph. fraterna</i>			<i>Ph. tristis</i>			<i>Ph. kentuckiana</i>		
		No.	Min.	Max.	Mean	No.	Min.	Max.	Mean	No.	Min.	Max.	Mean
A	Lexington	5	7.5in.	9.5in.	8.4in					2	8in.	13.5in.	10.8in.
B	Lexington	1	9in.	9in.	9in.								
C	Lexington	3	4in.	9in	7in.					1	9in.	9in.	9in.
D	Minorsville					6	4in.	17in	10.2in.	2	5in.	5.5in.	5.3in

most important and fertile soil of the Inner Bluegrass Region. The area sampled was a high, well drained bottom land located five miles northeast of Lexington. Area BA was in sod and adjoined Area B. It was a very shallow phase of Maury silt loam located on a steep west slope.

Area C was a bluegrass pasture located on the Experiment Station Farm at Lexington. The soil type was Maury silt loam. The grub infestation was confined mainly to the higher part of a south to southeast slope. Area D was woodland, wild grass pasture located near Minorsville in Scott county, in the hill region that surrounds the Inner Bluegrass Region. Much of this area is poorly drained. Certain samples were dug in Eden clay while others were dug in heavy silt loam underlaid by Eden clay. Most of the beetles were obtained from the lower parts of the hill sides. Few were found on the higher, more rugged slopes.

Discussion

Ph. hirticula. This species is the dominant May beetle in the Inner Bluegrass Region of Kentucky and constitutes over 88 per cent of the population (Table 3). **Ph. hirticula** larvae, regardless of soil type, almost always pupate at least several inches below the plow line, if the plow line is assumed to be six inches (Table 1). Grubs of this species pupate at approximately the same depths in the fertile bluegrass pastures of eastern Kentucky as they do in the permanent bluegrass pastures of southern Wisconsin.

Ph. inversa. Slightly less than four per cent of the May beetles found in the Inner Bluegrass Region belong to this species. Larvae of **Ph. inversa** pupate at shallow depths even in the same samples where grubs of **Ph. hirticula** were found pupating deep in the soil. In heavy soils, **Ph. inversa** usually pupates above the plow line.

Ph. futilis. Most of the pupation records for this species were secured in Area C where this usually unimportant species was quite abundant. According to the records, half of the **Ph. futilis** larvae in this field pupated above the plow line. The data for Area C, however, does not give a true picture since the writer found later that he did not examine the soil to a sufficient depth. Many empty pupal cells and old exuviae were observed two years later at depths greater than the maximum given in the table.

Many of these were thought to be of **Ph. hirticula** which was present in greater numbers on this farm than the diggings showed. In Area A, where nine pupation records of **Ph. futilis** were secured, no evidence of this species pupating above the plow line was found.

Ph. fusca. A few records were secured for this uncommon species in three areas. Although the species pupated at rather shallow depths, only one individual was found above the plow line.

Ph. bipartita. Grubs of this species are very scarce in the Inner Bluegrass Region but are abundant in certain areas of the Intermediate Bluegrass Region and of Western Kentucky. Larvae of **Ph. bipartita** usually pupated deeper in the soil than did larvae of **Ph. inversa**, even in the same samples. Only four out of 47 individuals of **Ph. bipartita** were found pupating at or above the plow line.

TABLE 3. May beetles collected in 1936 in Fayette County, Kentucky.

Species	No. of beetles collected	Per cent of total
Ph. hirticula	9,759	88.2
Ph. inversa	407	3.7
Ph. futilis	340	3.1
Ph. hornii	224	2.0
Ph. tristis	201	1.8
Ph. fusca	67	0.6
Ph. rugosa	42	0.4
Ph. kentuckiana	8	0.1
Ph. bipartita	5	0.1
TOTAL	11,053	100

Other species. A few records for **Ph. fraterna**, **tristis**, and **kentuckiana** were obtained but the data is too meager to permit any conclusions.

Summary

Few definite statements are found in the literature concerning the depths at which the various species of *Phyllophaga* pupate. Data on the pupation depths of

320 white grubs belonging to eight species of Kentucky May beetles is presented. It was found that *Ph. hirticula* larvae usually pupate deep in the soil while larvae of *Ph. inversa* pupate at shallow depths. *Ph. futilis*, *fusca*, and *bipartita* usually seek intermediate depths for pupation. Certain factors such as soil structure, soil drainage, and soil moisture may affect the pupation levels but they do not appear to change the relative positions of the various species. Differences in latitude appear to make little difference in the depth of pupation for a given species, other factors being equal.

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HABITS OF *Aedes thibaulti* DYAR AND KNAB.¹ (DIPTERA, CULICIDAE)

WILLIAM R. HORSFALL, Fayetteville, Arkansas

Aedes thibaulti is a mosquito of local importance which has been reported from Georgia, Alabama, Mississippi, Louisiana, Arkansas, and Missouri (1), (2), (4), (5). It is strictly a woodland species which is further localized because of the small number of suitable breeding places and by the short flight range of the adults. Nevertheless, it is a pest mosquito with which one has to contend when he is within the flight range.

This mosquito is a tree-hole species which requires a specific type of hole in which to breed. In Arkansas, larvae were found in only two of 41 holes in trees and stumps of varying sorts and in varying conditions under observation during 1935 and 1936. These were large cavities in the bases of sweet gum trees with openings so near the ground level that they were subject to flooding whenever the adjacent, intermittent stream reached flood stage. No larvae were ever collected from similar cavities in stumps or oak trees or from small holes in gum trees above the over-flow level. In Alabama, Shields and Lackey (4), collected larvae from similar holes in tupelo gum trees which stood in a semi-permanent pool.

Another reason why this mosquito is not widely spread over its range is that under ordinary conditions the adults will not fly far from their breeding places. No adults were collected over 50 feet from the water course along which they developed, although they ranged up and down the stream for greater distances.

The adults are not usually listed among the vicious species because they are not frequently encountered. Nevertheless, the bites are painful and the wheals often remain a day or more. The females attack readily when one passes near or disturbs the bushes or moss in the vicinity of the breeding places. However, those found resting within the cavities from which they emerged ordinarily did not bite.

This species of mosquito occurs only in the spring according to reports, (1), (3), (4), (5). In southeastern

¹Research Paper No. 630, Journal Series, University of Arkansas.

Arkansas, the larvae were found only during late February and early March in the years 1935 and 1937. On the other hand in northern Alabama, Shields and Lackey collected the larvae from March to late May from the trees in a shallow ground pool. This difference in time of collection may be explained by a possible difference in temperature of the water as well as by differences in the fluctuation of the water levels. It is likely that when the water was at the hatching temperature, each rise of the water level enabled other broods to develop. In southeastern Arkansas the breeding places were not known to have been flooded after the middle of March either year except once during late summer.

That the eggs may remain visible for more than one year in the field is indicated by observations in Arkansas. In the two known breeding places, eggs laid in 1935 had no opportunity to hatch in 1936 because the cavities were not flooded. Furthermore, there were no adults collected near these cavities that year. However, in 1937 larvae were again collected in these places in late February after flooding by winter rains. This delayed development will enable the species to endure unfavorable weather conditions of one or possibly more years.

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A NOTE ON SIGARA GRIFFINI (KIRK.)**H. B. HUNGERFORD, Lawrence, Kansas ***

Kirkaldy described *Corixa griffini* from "Lago di Kingora; Harro" in 1899 from material in the Museum of Zoology and Comparative Anatomy at the University of Torino, Italy. He did not mention the number of specimens before him, but besides the material returned to the museum at Torino he retained two female cotypes, which I have seen.

Dr. Jaczewski (1933) examined two type specimens which he secured from the University of Torino and assigned the species to the genus *Sigara*, a genus in which the males are typically dextral in their abdominal asymmetry. He also compared them with a male paratype of my *Corixa williamsi* and reports that my species is a synonym, and I agree with him. Kirkaldy did not mention whether his male specimens were sinistral or dextral, but did place his species in *Callicorixa*, indicating the absence of a strigil. In describing *Corixa williamsi* I had three males, two of them were sinistral and one dextral, which made it impossible to decide whether the species is typically left or right-sided in the male. I now have a good series of this species from various places in Peru and Ecuador, South America. The collections were made in March, April, May, June, and August, at elevations varying from 1900 to 4000 meters above sea level. Out of 1274 specimens there are 751 males, only 6 of which are dextral. It is quite safe to say that the species is typically sinistral in the male and that the 6 dextral specimens are cases of reversed asymmetry. Reversed asymmetry in male Corixidae was reported by me for *Corisella edulis* (Champion) in 1928, and by Dr. Jaczewski for *Kirzousacorixa femorata* in 1931. I have found it quite common in the genus *Centrocorixa* and in some other species of Mexico.

* Contribution from the Department of Entomology, University of Kansas.

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CONTENTS OF THIS NUMBER

STUDIES IN NEOTROPICAL STRATIOMYDIE (DIPTERA) —MAURICE T. JAMES (Concluded from Vol. 12. No. 1)...	37
NEW AND LITTLE KNOWN PHYLLOPHAGA FROM TEXAS, (SCARABAEIDAE, COLEOPTERA)—H. J. REINHARD ...	47
OBSERVATION ON WHITE GRUB PUPATION—P. O. RICHER	64
HABITS OF AEDES THIBAUTI DYAR AND KNAB. (DIPTERA, CULICIDAE)—WILLIAM R. HORSFALL	70
A NOTE ON SIGARA GRIFFINI (K'RK.)—H. B. HUNGER- FORD	72

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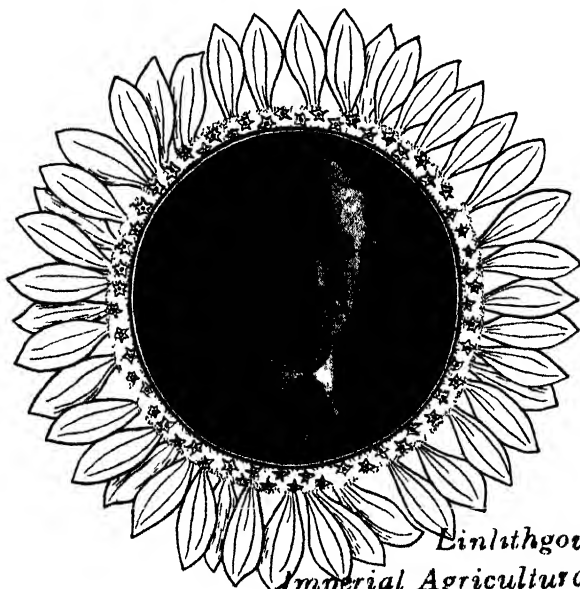
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SOME FACTORS INFLUENCING THE NUMBER OF MOLTS OF THE GERMAN ROACH

Lois Seamans and Laurence C. Woodruff*

In the pursuit of research problems, side issues often become evident which complicate the situation materially or which create such extreme interest that they absorb the main effort of the investigation. While not strictly true in the present instance, these observations were certainly incidental to the intended purpose of the project during which they were made.

It is a well known fact that many insects show a tendency to vary in the number of stadia undergone during the developmental period. The exact explanations of these phenomena are not well understood and seem to be accountable to a number of causes; perhaps the answer lies with the individual insect and is not to be found in studies of simple variables. In general, however, additional ecdyses seem to arise from adverse conditions of the environment. It has been the thesis of the junior author that growth problems in animals are mainly genetic in their nature but variable according to the effects of certain contributing extrinsic factors. Just what reconciliation can or need be made between this general idea and the facts of variable molting is a discussion beyond the limits of this paper.

While some kinds of roaches undergo more than a dozen stadia, those of the species involved here (*Blattella germanica* L.) normally molt six times in completing their growth, a fact substantiated by carefully observed developmental studies including many hundreds of life histories. Detailed records on molting have accumulated during the course of nutritional and growth experiments which while incidental to the main theme of the research are none the less interesting and have their bearing in establishing norms from which to judge variations. Naturally, extensive or consistent deviations attract attention and are worthy of mention if for no other reason than to show the value of the average condition.

During previous research of the junior author, extra molts had been observed frequently among the individuals of an experimental lot, provoking no very evident or striking conclusion except that they apparently occurred more commonly among those whose living conditions were not the optimum. In the process of growth studies involving the rate of regeneration of lost or experimentally amputated appendages (legs), evidence was compiled which indicated that such injury caused a frequent incidence of an added instar. Planned experiments have been launched to investigate further the exactness of this relationship but only those data which were acquired from

*Contribution from Department of Entomology, University of Kansas.

the aforementioned problem will be discussed at present.

The dictates of the growth rate experiments required that all individuals be fed an identical diet and otherwise handled in a standardized manner. The food, which previous tests had shown to be complete in a dietary sense, consisted of a finely ground mixture of 40% whole wheat flour, 40% dry skimmed milk, and 20% brewer's yeast. In so far as possible roaches emerging from the same capsule were divided into experimental and control groups, although not necessarily in equal numbers. Experimental animals were those from which one or two legs had been amputated. Forcible removal (appendotomy) was affected in such a manner as to sever the appendages at the articulation between the trochanter and the femur. The metathoracic leg was always selected for a single amputation, and in the cases of insects suffering double injury the mesothoracic leg of the same side of the body was also removed. All amputations were performed within 24 hours of eclosion. As development progressed molts were determined by measurements of the sclerotized parts of the body.

Of several hundred animals allotted to this series of experiments, 170 attained adulthood and all records were drawn from these for which full particulars were available. A total of 56 control roaches on which no injury was inflicted developed to maturity. All of these molted the normal number of six times. Development was at its best and the usual time required from egg to adult was around 50 to 60 days.

By no means did every individual undergoing an injury exhibit an extra molt, but among the experimental animals frequent instances of an additional stadium were encountered, leading to the suspicion of a definite connection between the two. Of 41 roaches which had a metathoracic leg removed, nine required seven stadia for complete development. Twenty-six molted seven times among the 73 which had both a mesothoracic and a metathoracic leg severed. Comparing these results with those of the uninjured controls where only the normal number of molts appeared, it is not difficult to conceive that the amputations inflicted upon the experimental animals have very definitely influenced the necessity of an additional growth period. There also appears to be a direct correlation between the incidence of the extra molt and the degree of the mutilation, approximately one-fourth of those which lost a single leg molting seven times as compared with over one-third of those undergoing a double injury. In no case however, were more than seven molts observed.

In another set of experiments consisting of feeding trials where the test groups were subjected to various types of deficient diets, an additional molt was also noted frequently, always among the experimental animals, while the controls receiving complete diets were normal in this respect.

Thus it would appear that adverse conditions of the environment tend to necessitate an extra stadium in the development of this insect which normally undergoes six molts. Minor deficiencies in the diet and injury each may produce such an effect. Possibly other factors will also prove to have a similar influence.

Two rather striking and decidedly interesting points are obvious in connection with this extra molt exhibited by the experimental animals. In the first place, the total size attained by a sclerotized part is slightly greater than is characteristic of the normal animal. This fact is shown clearly in the accompanying table where data for the metathoracic tibia, cranium, and pronotum are shown. In each

Measurements and growth ratios for roaches undergoing six and seven molts

Stadia	Average Measur'ment	Ratio	Stadia	Average Measur'ment	Ratio
--------	------------------------	-------	--------	------------------------	-------

Metathoracic Tibia

1	0.82	----	1	0.85	----
2	1.11	1.36	2	1.09	1.28
3	1.46	1.32	3	1.44	1.32
4	1.90	1.30	4	1.79	1.24
5	2.53	1.32	5	2.27	1.27
6	3.33	1.32	6	2.84	1.25
			7	3.60	1.27
Adult	4.67	1.40	Adult	5.00	1.31

Cranium

1	0.73	----	1	0.72	----
2	0.88	1.21	2	0.86	1.19
3	1.08	1.23	3	1.02	1.19
4	1.28	1.19	4	1.20	1.18
5	1.54	1.20	5	1.42	1.18
6	1.82	1.18	6	1.66	1.17
			7	1.90	1.14
Adult	1.98	1.09	Adult	2.09	1.09

Pronotum

1	0.99	----	1	0.97	----
2	1.34	1.35	2	1.27	1.31
3	1.77	1.32	3	1.63	1.28
4	2.23	1.26	4	2.02	1.24
5	2.78	1.25	5	2.44	1.21
6	3.47	1.25	6	3.04	1.25
			7	3.66	1.20
Adult	3.48	1.00	Adult	3.74	1.02

case, the definitive size is noticeably larger for the seven than for the six molt type of development. Secondly, the additional instar appears not to be merely appended to the six normal periods, but manifests itself early in the life of roaches which will undergo it, and is strikingly evident for the greater part of the developmental period. Somewhat confusing testimony as to its origin is displayed by the table

of average measurements and growth ratios. In the tibia, differentiation is clearly apparent for the first time only after the third molt, but in the cranium and pronotum it can be detected at least at the second or perhaps at the first ecdysis. In keeping with the added growth period, the progression factors for the seven molt type of development are naturally a little smaller and to some extent more uniform throughout their range.

SUMMARY

Blattella germanica normally undergoes six molts, but when subjected to a less nutritious diet or when minor injuries are inflicted, seven stadia may be required for complete development. Injuries in the form of leg amputations (appendotomy) appear to influence the incidence of the extra molt according to the degree of the injury. A greater proportion of individuals suffering a double amputation was forced into an extra stadium than was true where only a single injury was involved. The additional instar is not merely appended to the six normal periods, but becomes evident in the early growth, resulting in a lowered progression rate during the remaining life, and culminating in a slightly greater size of the sclerotized parts of the body.



MASS FLIGHTS OF THE PENTATOMID, *THYANTA CUSTATOR* (FABR.), IN KANSAS

Donald A. Wilbur, Kansas Agriculture Experiment Station

For the third successive year, mass flights of the common stink bug, *Thyanta custator* (Fabr.) have occurred somewhere in the Central States region. The most recent were the mass flights which took place during the evening of Oct. 14 and were reported in twelve localities representing ten counties in Kansas. These localities are as widely separated as Elkhart, in the extreme southwest corner of the state, and Hiawatha in the extreme northeast corner. The other localities are scattered along a direct line across the state between these two towns. It is remarkable that none of the localities from which records of the bug swarms were secured are farther than 20 miles off of this direct southwest-northeast line.

The two previously recorded swarms occurred at approximately the same time of year as the recent one. Severin² observed unusual swarms at Sioux Falls, S. D., on Oct. 5, 1936; and Ainslie³ recorded immense swarms at Sioux City, Iowa, on Oct. 8 of the following year.

The recent flights attracted much local attention because they were observed by crowds that attended the high school football games held on Friday night. The football fields, each of which was brilliantly lighted by floodlights with from twelve to twenty-four 1500 watt lamps, attracted the bugs which soon settled over the field to the extreme annoyance of both spectators and players. The annoyance resulted not only from the presence of the insects, but also from their obnoxious odor. At Wilson and Sylvan Grove, the games had to be called off, while at other places the bugs caused the games to be temporarily interrupted, and resulted in the early departure of most of the spectators.

Records of the flights were secured for each of the following places (fig. 1) listed in the order of their location from the southwest to northeast; Elkhart, Morton Co.; Dodge City, Ford Co.; Larned and Rozel, Pawnee Co.; Hoisington, Barton Co.; Wilson, Ellsworth Co.; Sylvan Grove and Lincoln, Lincoln Co.; Minneapolis, Ottawa Co.; Clay Center, Clay Co.; Leonardville, Riley Co.; Hiawatha, Brown Co. The records were secured from the reports of the county agents,⁴ from correspondents and from examining files of newspapers from all parts of the state. It is not known whether these flights

¹ Contribution No. 464 from Department of Entomology

² Severin, H. C.—Unusual abundance of *Thyanta custator* (Fabr.) in South Dakota. Jour. Econ. Entomology 30: (1) p. 210, 1937.

³ Ainslie, C. N.—Swarms of the Common Pentatomid, *Thyanta custator* (F.) in Iowa. Jour. Econ. Entomology 31: (1) p. 130, 1938.

⁴ The reports from the county agents were supplied by Dr. R. C. Smith and Dr. E. G. Kelly.

resulted in an extensive migration or whether the insects originated in the locality in which they were observed swarming about the lights.

The characteristic features of the flights were their sudden appearance, their incredible numbers, the accompanying noise, the disagreeable odor, and their occurrence on one night only. The following excerpts or statements of observers indicate these characteristic features:

Wilson—"The bugs seemed to come from the north, struck buildings and piled up. One awning when let down had more than a bushel."

Dodge City—"Millions of insects swarmed this town on the night of Oct. 14."

Elkhart—"Traffic is said to have been stopped by the bugs."

Clay Center—The Topeka Daily Capital shows a picture of three men loading the bugs upon a truck in front of the business district in Clay Center. Two large truck loads of bugs were hauled away on the morning after the flight. The bugs appeared at about 8:00 p. m.

Minneapolis—The Minneapolis Messenger says that just about anyone to whom the invasion is mentioned replies that the bugs were thicker than he ever saw them before under any circumstances. It further reports that on the Ottawa County bank corner the bugs were piled up in a drift the next morning and had to be hauled away in a truck after the bugs had been killed by putting kerosene on piles of them.

Hoisington—The Hoisington Dispatch states that at the football field, when the swarms of bugs were the thickest, one could hardly see the players on the field. The bugs made a noise like many swarms of bees. At the close of the game they were piled five inches deep at the base of some of the flood light poles. In the oilfields north and northwest of Hoisington the bugs almost stopped drilling operations. They swarmed only the one night.

Leonardville—Mr. C. E. Moll, who officiated at the football game at Leonardville, supplied the following account of the Leonardville flight:

"At about 8:15 p. m. the bugs made their first appearance. Spectators were first made aware of their presence by the din caused by the whirring of wings. Many thought that a grasshopper invasion was coming. For several minutes the bugs milled about over the field and around the lights looking like snowflakes in a whirlwind. Presently some of the bugs began to come to the ground among the spectators. The band, located in the best lighted portion of the stands had to move immediately. The lights were reduced during most of period between halves and were completely turned off for a few moments. A portion of the bugs settled but started flying again as soon as the lights were switched on. It was necessary

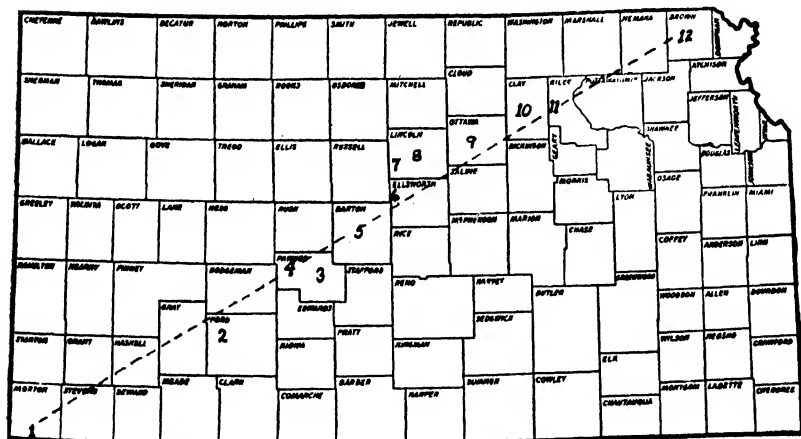
to turn off the lights for a second and longer time before play could be resumed. For a while it was exceedingly doubtful whether the game could be completed."

"The offensive stinkbug smell permeated the neighborhood, especially after spectators and players had crushed the bugs with their shoes and clothing. By the time the game was over, most of the bugs had settled to the ground under the light poles. The bugs were from 1½ to 3½ inches deep under one pole over an area of more than 450 sq. ft. There were not as many under any of the other seven poles."

The flight followed the warmest two-weeks period ever recorded in Kansas during the month of October. The night of the fourteenth was warm, clear and, in most places, quiet. Mr. S. D. Fiora, meteorologist with the Weather Bureau at Topeka, Kansas, was consulted regarding the unusual invasion and requested to suggest any meteorological phenomena that might help to account for the southwest-northeast line distribution of the swarms. He replied as follows:

"The map for the morning of the 14th shows a decided area of high pressure in the far northwest with surface winds from the northwest as far south and east as North Platte and southerly winds

FIG 1
MAP OF KANSAS INDICATING THE TOWNS FROM WHICH
RECORDS OF THE MASS FLIGHTS OF THYANTA
CUSTATOR ON OCT. 14 WERE SECURED



1. Elkhart
2. Dodge City
3. Larned
4. Rozel
5. Hoisington
6. Wilson

7. Sylvan Grove
8. Lincoln
9. Minneapolis
10. Clay Center
11. Leonardville
12. Hiawatha

over Kansas. It is entirely possible that by the evening of the 14th, upper air currents were from the northwest north of a line drawn diagonally from the northeast corner of Kansas to the southwest corner of the state and that southerly winds prevailed southeast of that line. It might have been possible that this meeting of two air currents, a cooler current aloft from the northeast and a warmer current from the south beneath, caused the bugs to descend along the line you mention, from Hiawatha to Elkhart. We often find a rain area extending in this diagonal direction under conditions similar to this, though in this case no rain resulted."

Thyanta custator is the most common Pentatomid in Kansas, where it is abundant throughout the growing season, both in cultivated fields and in weedy patches. It overwinters as an adult and can be found early in the spring feeding on wheat. In Kansas, it has innumerable color grades, varying from a bright green with pinkish markings to brownish fuscous with pale yellow markings. There were no indications of an unusual abundance of the bug prior to the flights.



THE GENUS *CALANA* DeL. (HOMOPTERA CICADELLIDAE)

R. H. Beamer, Lawrence Kansas*

The genus *Calana* was described by DeLong in Ohio Jr. Sci., Vol. 36, July, 1936, with the designation of "*Thamnotettix umbricatus* Ball" as genotype. This was evidently an error in spelling as the generic description fits *Thamnotettix umbratica* Ball and there is no such species known as *umbricatus* Ball.

In addition to the things set forth in the original description, this genus is characterized by a very large anal tube.

Calana umbratica (Ball)*Thamnotettix umbratica* Ball, E. D. Can. Ent., p. 309, 1910

Numerous specimens of this species are at hand from many different localities in California. From this series it would seem that the unmarked specimens are most common.

Genitalia. Pygofer longer than wide, rounded at apex with large hook or spine near middle of dorsal margin and a smaller one at apex. Anal tube as long as pygofer, but not quite as wide; aedeagus in lateral view very broad, almost one-fourth as wide at base as length, curved dorsally, U-shaped with a pair of lateral, diverging processes one-fourth distance from tip, slightly longer than width of shaft at this point, ventral margin rapidly converging from base of processes to long slender apex on dorsal margin; styles wide at base, narrowed at middle to less than one-fourth basal width, slightly wider on outer half, apices rounded.

Calana bispinosa n. sp.

Resembling *C. umbratica* (Ball) but elytra almost truncate at apices and plates of male with deep notch on mesal margin. Length 3.5-4 mm.

Vertex sharp, less than a right angle, definitely longer at middle than width between eyes, disc slightly convex, rounded at margin. Elytra longer than abdomen, sides almost parallel, apices almost truncate, flaring.

Color tawny with darker markings. Vertex with darker median longitudinal vittae and often darker line next margin and bordering eyes; pronotum with three darker longitudinal stripes, median growing wider posteriorly, ending at tip of scutellum. Elytra hyaline, with veins light, more or less bordered with fuscous.

Genitalia: Last ventral segment of female about twice as wide as preceding, posterior margin slightly excavated with median third extended equal to lateral margin. Valve of male broadly triangular; plates narrower at base than valve, outer margin evenly rounded to inner; a deep cleft or notch on inner margin just beyond middle; pygofer longer than broad, outer margin rounded with two spines or

*Contribution from Department of Entomology, University of Kansas

hooks, one on outer dorsal margin and the other at apex under large dark blotch; style broad at base, narrowing to middle, gradually widening to broad knife-like apices; aedeagus long and narrow, in lateral view curved dorsally into a semicircle.

Holotype male, allotype female and eight pairs of paratypes, Irvine Park, Orange County, California, August 4, 1938, R. H. Beamer.

Types in Snow Entomological Collection, Lawrence, Kansas.

Calana rubralineata n. sp.

Resembling *C. umbratica* (Ball) but smaller, longitudinal line of vertex usually red and aedeagus of male quite slender in lateral view, forming almost a complete circle. Length 3.25-3.5 mm.

Vertex sharp, about a right angle, disc slightly convex; elytra longer than abdomen, apices rounded.

Color: semihyaline to tawny; vertex with ocelli usually dark and with a median longitudinal red line; pronotum usually with semblance of dark longitudinal vittae; elytra semihyaline with veins light, more or less bordered with fuscous.

Genitalia: Last ventral segment of female half as long again as preceding, posterior margin broadly and rather deeply excavated. Valve of male broadly angular, plates about as wide at base as valve, lateral margins converging to sharp apices, inner margins diverging on outer half. Pygofer longer than wide with rounded apex, no hooks or spines; anal tube longer than pygofer; styles very broad at base, gradually narrowed to about one-fourth basal width at middle, but slightly narrowed to tips, almost straight throughout and almost as long as plates; aedeagus in lateral view very long and slender, curved dorsally almost into a circle, with a pair of lateral processes slightly beyond middle, slightly less than half as long as half distance from their attachment to tip, shaft suddenly narrowing on ventral margin to about half its width just beyond processes.

Holotype male, allotype female and numerous paratypes, Monterey, California, August 22, 1935, R. H. Beamer; two males and twenty-nine females, Del Mar, California, June 2, 1935, P. W. Oman.

Types and paratypes in Snow Entomological Collection, Lawrence, Kansas; paratypes in U. S. National Museum, Washington, D. C.

The red mesal line of vertex is not present in some specimens, but a semblance of this red line can usually be detected.

THREE NEW DOLICHOPODIDAE¹F. C. Harmston and G. F. Knowlton²

The three species of flies here described as new were present in collections received from Professors H. E. Jaques of Iowa Wesleyan College and H. C. Severin of South Dakota State College.

Dolichopus facirecedens n. sp.

Male. Length 4.5 mm; of wing 3.8 mm. Front dark purple, slightly greenish near base of antennae; face moderately wide, covered with golden-brown pollen which is thinner at lower base of antennae, allowing greenish ground color to show through; lower one-fourth of face receding at approximately a 30° angle leaving the inner ventral margin of each eye sharply exposed; palpi dark velvety brown; antennae (fig. 4) yellow, third joint brownish on apical one-half; lateral and inferior orbital cilia wholly black.

Thorax dark green with purplish reflections; pleurae dulled with white pollen. Abdomen dark shining green with coppery reflections; hypopygium black, its lamellae (fig. 6) of moderate size, brownish with broad black border, scarcely jagged but with a deep apical cleft, fringed with long brownish hairs.

Front coxae yellow, slightly infuscated on outer basal margin and clothed on front surface with dense, tiny black hairs; middle and hind coxae black with narrow yellow tips; femora yellow, middle and hind pair each with one preapical bristle, the latter ciliated near the middle of lower inner edge with about twelve long black hairs; front tibiae yellow, slightly infuscated on apical anterior margin; middle tibiae black except basal one-fourth yellow, and distal portion distinctly thickened; the bristles of both middle and hind tibiae strong; all tarsi black; fore pair with first joint as long as second plus third; middle basitarsi with one small bristle above and having two rows of small bristles on lower edge. Knobs of halteres and calypters yellow the latter with black cilia.

Wings (fig. 5) brownish; costa with elongate enlargement at tip of first vein; last section of fourth vein abruptly bent near its middle;; veins of wing noticeably infuscated; anal angle rounded, not prominent.

Female. Face wider than male; third antennal joint smaller; wings more uniformly brownish; hind femora not ciliated; posterior tibiae not thickened; middle basitarsi without bristle on upper surface; otherwise approximately as in the male..

Described from two males and two females.

Holotype, male, taken at Waubay, South Dakota, June 22, 1936, by H. C. Severin; allotype, female, taken at Martin, South Dakota,

¹Contribution from the Department of Entomology, Utah Agricultural Experiment Station.

²Research assistant and research associate professor of entomology, respectively.

July 6, 1924, by H. C. Severin; paratype, male, taken in Dickinson County, Iowa, June 24, 1938 by B. G. Berger, and, one paratype, female, Dickinson County, Iowa, June 25, 1936, by D. Millspaugh.

Taxonomy. This species runs to *bruesi* V. D. in the Van Duzee and Curran keys (American Museum Novitates, numbers 683 and 684) from which it differs in many respects, such as: longer and narrower wings, antennae principally yellow, and possessing a deep cleft on apical margin of hypopygial lamella.

***Dolichopus iowaensis* n. sp**

Male. Length 3.5 mm.; of wing 3 mm. Face moderately wide, sides nearly parallel, covered with ochre-yellow pollen; front dark bluish-green, very lightly dusted with golden pollen; antennae (fig. 2) black, third joint about three times as long as wide, acutely pointed at tip and densely pubescent with whitish hairs; arista about same length as third joint and arising from the dorsal surface near the apical fourth; lateral and inferior orbital cilia white, the black cilia descending about one-third the eye height.

Thorax dark green, dorsum and pleurae slightly dulled with white pollen. Abdomen dark green with narrow black incisures; base of first segment and lateral margins of others dulled with white pollen; hypopygium large, black; its lamellae (fig. 3) small, oval, whitish with a black border on apical margin, jagged and bristly, fringed above with pale hairs.

Fore coxae yellow with a brownish spot at base on outer side, front of fore coxae covered with minute, black hairs; middle coxae black with narrow yellow tips, their front surface covered with many delicate black hairs and slightly dusted with white pollen; hind coxae black with narrow yellow tips; femora yellow, middle and hind pair each with one preapical bristle, the latter without cilia below; fore and middle tibiae yellow; the fore tibiae with a yellowish-brown, hair-like bristle at apex on outer side which is nearly one-half the length of basitarsus; hind tibiae yellow with black tip, very slightly thickened; fore tarsi about same length as their tibiae, first joint as long as the three following joints taken together; tip of first and second tarsal joints black, remaining joints entirely black; middle basitarsi yellow with apical portion infuscated, second joint yellow with black tip, remaining joints black; hind tarsi black, the first and second joints of nearly equal length. Calypters and halteres yellow, the former with black cilia.

Wings (fig. 1) grayish; costa with an enlargement at tip of first vein which tapers gradually toward apex of wing; last section of fourth vein slightly bent near middle.

Described from one male collected in Dickinson County, Iowa, June 24, 1938, by B. G. Berger.

Taxonomy. This species runs to *simulans* V. D. in the key to males of Nearctic *Dolichopus*, (American Museum Novitate, No. 638)

from which it differs in: third antennal joint being more acutely pointed and pubescent, surface of fore coxae clothed with black hairs, the middle and hind coxae black with narrow yellow tips, palpi black and face covered with ochre-yellow pollen, and having the costal margin of wing much less thickened.

Argyra dakotensis n. sp.

Male. Length 3 mm., of wing 3mm. Face and front silvery white; palpi brownish, velvety; proboscis black with brownish hairs; antennae (fig. 7) black; first joint long, hairy above; third nearly three times as long as wide, obtusely pointed; arista but slightly longer than third joint. Lateral and inferior orbital cilia white.

Dorsum of thorax shining green, slightly dulled with white pollen, scutellum with four marginal bristles, without hair on its disk; pleurae darker, thickly coated with white pollen. Abdomen shining green; a large yellow spot on the sides of the first, second, third and fourth segments, a less clearly defined spot on the fifth segment; the yellow of the abdomen leaves narrow anterior, posterior and median dark green lines; abdominal hair entirely black. Hypopygium small, black, its outer lamellae brownish, rounded at tip; inner appendages yellowish-brown, rounded at tip.

Coxae yellow; hairs and bristles of fore coxae whitish; anterior surface of middle coxae with dense black hairs; a single black bristle on outer surface of hind coxae.

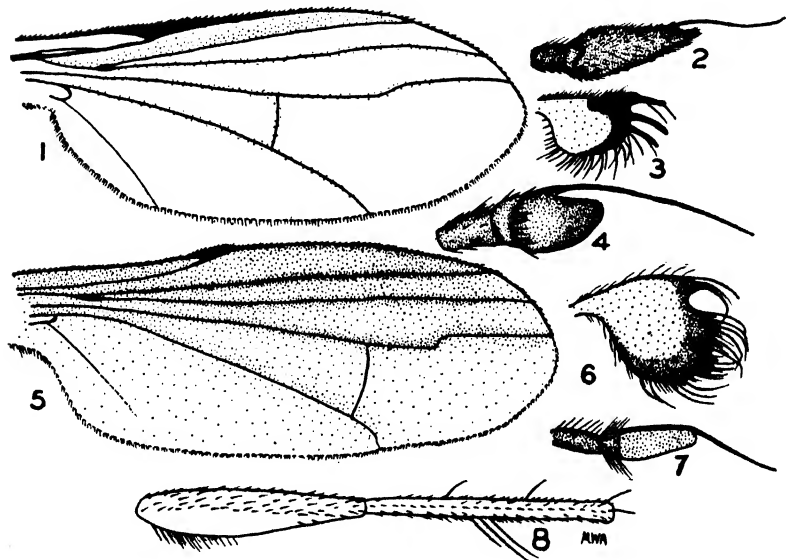
Femora and tibiae yellow, tips of posterior tibiae infuscated; middle femora slightly swollen at base and bearing numerous hair-like bristles on ventral surface (fig. 8). Middle tibiae with two long bristles near their middle (fig. 8). Fore tarsi with fifth joint black, other joints yellow with black tips; middle tarsi blackish from tip of first joint; hind tarsi wholly black; joints of fore tarsi as 13-5-4-3-2; of middle tarsi as 16-6-5-4-3; of hind tarsi as 11-10-6-5-4. Calypters and halteres yellow, the former with yellow cilia.

Wings grayish; third vein slightly bent backward at tip; fourth vein nearly parallel with third, last section of fifth vein slightly more than twice as long as the cross-vein.

Described from one male taken by H. C. Severin at Pineridge, South Dakota, July 8, 1924.

Taxonomy: This species runs to *calceata* Lw. in the Van Duzee key to *Argyra* males, (U. S. Nat. Museum. Proc. 66, No. 23.) but differs in being smaller, lacking black bristles on anterior coxae, longer and less pointed antennae, darker tarsi, and in possessing two long prominent bristles on outer surface of middle tibiae.

Type in collection of Utah Agricultural Experiment Station.



Dolichopus iowaensis n. sp. 1-3; *D. facirecedens* n. sp. 4-6; *Argyra dakotensis* n. sp. 7-8.

SOME NOTES ON THE NESTING HABITS OF *BATAZONUS NAVUS* CRESSON*

Robert E. Bugbee, College of Emporia, Emporia, Kansas

OBSERVATIONS ON *B. NAVUS*

A number of these wasps were observed along the north shore of Reading State Lake, Lyon County, Kansas. It was late in September of 1938, and they were burying their spiders in a sun baked clay and dirt mixture which earlier in the summer had been under several inches of water. The former shoreward edge of the lake was marked by a stand of short weeds interspersed with tall bunches of blue stem grass.

My attention was first attracted to them by the discovery of the lifeless body of a spider (probably *Argiope trifasciata*) lying across a bent weed stem. Later several specimens of *Argiope aurantia* were also found. Both these spiders seem to be common in this vicinity in the fall where they spin their circular webs among the blue stem grass and low bushes and take a heavy toll of grasshoppers. *Batazonus navus* did not prey upon the large fullgrown spiders but chose only half-grown individuals.

Like some other species of the spider hunting wasps *B. navus* secured her prey first before locating her nesting site. The spiders were dragged to the spot along the lake shore and left some six to eight inches from the digging operations. The actual nesting site was sometimes a bare patch of ground under cover of low, scattered weeds and at other times in bare areas with no sheltering vegetation whatsoever. In several cases the spiders were left, during the digging operations, balanced across some bent or fallen grass stem an inch or so above the ground. At other times, however, the limp bodies were simply left on the ground. Peckham (1898) records similar actions for *Episyron quinquenotatus* (*Pompilus quinquenotatus* of Peckham) which either placed their spiders in the crotch of a nearby plant or left them on the ground. With the spiders located one way or the other the wasps along the lake shore commenced to dig and in a few minutes had holes opened in the earth the diameter of a common lead pencil. They frantically removed small pellets of earth with their mandibles and dropped them at the edge of the holes. In all cases observed the wasps faced westward during the whole process of digging, and the collection of removed debris thus stretched eastward behind them. As the holes grew deeper, they would plunge in head first and then back out again quickly, dropping their pellets of earth. From time to time they would pause long enough to sweep the dirt, which accumulated too near the edges of the burrows, backwards and under them with their front legs, walking

*Kindly identified by Mr. Nathan Banks, Museum of Comparative Zoology, Cambridge, Mass.

backwards as they did so. They might also dash over to the spiders and reconnoiter briefly and hurriedly, although several of the wasps completed their digging before the spiders were examined again. If the wasps were disturbed during the mining operations they would quickly retreat to the covering of the weeds and grass.

Eventually satisfied that their burrows were ready the wasps backed out and hurried to the spiders. Grasping them by the coxae of one of the legs they tugged them jerkily to the burrow openings. This time they backed down the holes and dragged their spiders over them. From underneath they manipulated them until they could grasp the tips of the abdomen. Slowly the spiders slipped out of sight with a jerky motion, the last to disappear into the darkness being the eight long legs which were forced together over their heads by the sides of the burrows. For perhaps four or five minutes nothing happened, then, movement in the holes showed the wasps were working their way out, head first, and they could be observed scraping loose dirt under them from the sides of the burrows. As soon as they emerged they brushed into the openings some of the loose soil from around the edges and then, backing down into the hole for about one-half of their length began a rapid up and down motion. During the course of this action they held the wings spread laterally as if about to take flight. At first this action was puzzling, but after several repetitions it became evident that they were thus tamping down the dirt. The motion was so fast that there literally hummed in my head the staccato hammerings of a riveting machine. The abdomen seemed to be curled ventrally and anteriorly so that the dorsal surface of the abdominal segments served as the tamper surface.

When the holes had been filled up flush with the surrounding surface, and the filler well packed down, they would pick up in their mandibles from nearby, small pebbles and even twigs and scatter them about over the former entrance and environs. The camouflaging was so clever that once you had shifted your eyes you might never be sure that you had located the spot again.

All the observations were made late in the afternoon and often the sun had set and dusk was approaching before the wasps were finished. The feverish haste, characteristic of all their actions, seemed to be concentrated in a race against the coming of darkness. Their haste suggests the actions of *Episyron quinquenotatus* which was christened by the Peckhams (1898), the "Tornado wasp." They add, "Never have we seen a creature so fiery, tempestuous, cyclonic." In all cases when *B. navus* had finished their burial they returned to the weeds nearby and, after cleaning themselves thoroughly, settled down among the leaves, apparently to rest and spend the night.

There may or may not be any significance in the fact that they seemed to limit their nesting activities to the late afternoon. On the

only morning trip that was made to the locality, no sign of the burrows or of the wasps could be found.

The whole procedure occupied on the average of from one-half to three-quarters of an hour.

Several of the nests were dug up. One went down into the earth at a gentle angle for about three and a half to four inches. The tunnel ended in a slightly enlarged chamber in which the spider rested. Another went straight down and was only two inches in depth. In this case the spider had not been placed in the enlarged chamber but had been left about mid-way in the tunnel.

A single small white egg was found attached to one side of the mid-ventral line on the abdomen of several of the paralyzed spiders.

DISCUSSION

The only references in the literature that I could locate which described anything similar to the rapid tamping action of *B. navus* was in *Wasp Studies Afield* by Phil and Nellie Rau (1918) and in *Instincts and Habits of Solitary Wasps* by G. W. and E. G. Peckham (1898). One of the species referred to by the Raus was *Pompiloides tropicus*. On page 54 their description read, "The abdomen was curled under the body, making the dorsal surface of the tip appear ventral; this convex portion, pressed against the ground, proved a very efficient sad-iron, smoothing and at the same time compressing the loose soil." Again on page 53, . . . "packing the loose dirt back into the hole with all her legs and punching it down with the tip of her ventrally curved abdomen." This use of the abdomen as a trowel or smoothing instrument is explained even more clearly by Rau (1928, page 343) in his discussion of *Pseudagenia mellipes*. In all cases the descriptions do not seem to imply the rapid tamping action of *B. navus* but the use of the abdomen more as a tool for smoothing and compressing the dirt.

The Peckhams noted the use of the abdomen for several species of Pompilids including, *Pompilus fuscipennis*, *Psammochares scelestus* (*Pompilus scelestus* of Peckham), and *Episyron quinquenotatus*. Their description of *P. fuscipennis* (page 141-142) sounded more like the action of *B. navus* than any of the others. One particular specimen that they watched brushing some soil into its hole . . . "began to dance up and down upon it, jamming it into place with her abdomen." In addition to the tamping action she also used it to rub, . . . "like a pestle in a mortar, and as a brush to sweep away dirt." This triple action, however, was only observed in this one specimen of many of the same species observed by them at one time or another.

From the above it may be gathered that the abdomen is used as a tamping tool by many of the Pompilids and that there is considerable variation in the method employed. All the species mentioned apparently use it to some extent for pushing earth down into the

holes and may further smooth or tamp the earth down more firmly with it. However, only the description of *P. fuscipennis* seems to tally with the rapid tamping action observed in *B. navus*. Moreover the instinct must be more firmly implanted in the latter as the action was observed in all the specimens which were allowed to complete the closing of the nest before they were captured.

In summary the following may be stated.

1. *Batazonus navus*, like other Pompilids, secures its prey first before locating its nesting site and burying its spider.

2. It preys upon spiders of the genus *Argiope* (*A. trifasciata* and *A. aurantia*).

3. It may or may not leave the spider balanced across some weed or grass stem an inch or so above the ground while it digs the nest.

4. It uses its abdomen as a tool in closing the burrows for tamping down the earth but, unlike other Pompilids, the action is very rapid.

5. The instinct seems to be well implanted in *B. navus* for it occurred in all the specimens observed.

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SOME OBSERVATIONS ON INSECT EDAPHOLOGY

W. G. Bruce, U. S. Department of Agriculture
Bureau of Entomology and Plant Quarantine

The plant ecologist (3) considers the following three environmental factors: Climatic, those which act upon the plant through the atmosphere; edaphic, those which operate through the soil; and biotic, those arising from the presence of other plants and animals.

In the study of insect ecology the entomologist has given most of his attention to two of these environmental factors, namely, the climatic and the biotic.

Insect edaphology (entomo-edaphology) may be defined as the study of those environmental factors affecting insects which operate through the soil. These edaphic factors include kind or type of soil topography, drainage, water content, hygroscopicity, air in the soil, vegetation, soil temperatures, soil solutes, etc.

A season may be too dry or too wet for the welfare of certain species of insects. It would be of interest to know whether such dryness or wetness is detrimental to the egg, larva, pupa, or adult, and to what extent climatic or edaphic factors are involved.

Experimentation and observation indicate that soil moisture is a determining factor in the scarcity or abundance of certain species of Diptera. Chapman and Cavitt (2) found that the percentage of soil moisture had a decided effect upon adult emergence of the pink bollworm *Pectinophora gossypiella* Saund. in both sandy-loam and clay-adobe soils. Commenting upon the influence of moisture on the larvae of *Lyperosia exigua* de Meij., Windred (5) writes, "Finally, there comes a point of dryness, as well as of wetness, where either the larvae cannot live or else they cannot pupate." Melvin and Bushland (4) state from their observations that as the moisture content of sand increased the emergence of *Cochliomyia americana* C. and P. adults was correspondingly reduced. It has been shown by the writer (1) that excessive soil moisture is detrimental to the development of *Hypoderma* pupae. Subsequent experiments with the pupae of horn flies (*Haematobia irritans* (L.)), screwworm flies (*Cochliomyia americana*), and houseflies (*Musca domestica* L.) indicate a similar relationship between soil moisture and pupal development.

For these tests 500 grams of air-dry fine sand was placed in each of a number of 1-pint, wide-mouth glass jars. A glass tube $\frac{1}{2}$ inch in diameter and 5 inches long was placed upright in the sand at the center of the jar, and a metal lid having an aperture for the glass tube and two additional $\frac{1}{4}$ -inch holes for the diffusion of air was fastened to each jar. One hundred pupae (50 pupae in the case of tests with horn flies) were buried $\frac{1}{2}$ inch deep in the sand around the tube in each jar. The estimated amount of water needed to make up the desired percentage of soil moisture was added through the

glass tube. The total weight of each jar and its contents was recorded and the jar thereafter weighed daily, sufficient water being added each day to maintain the designated water content. The jars were kept in an insectary at a temperature of approximately 80° F. To check the moisture content at the conclusion of the experiment, soil samples from around the pupae in each jar were dried in an electric drying oven at 225° F. for 20 hours and the percentage of soil moisture determined.

The results of these tests are shown graphically in fig. 1.

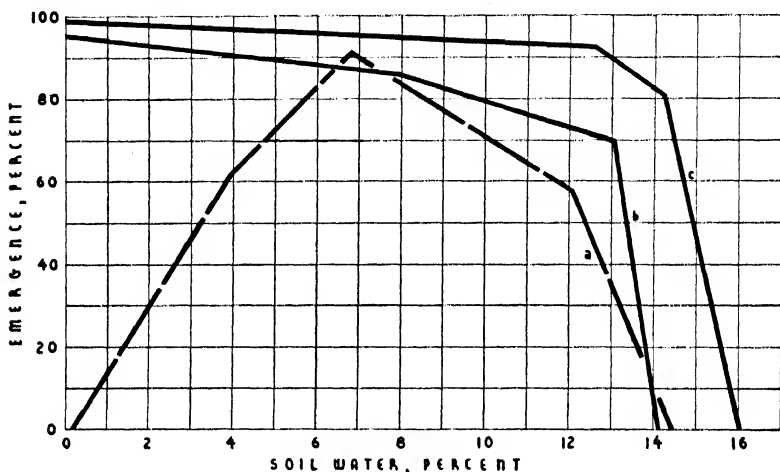


Fig. 1 Approximate curves showing relationship between soil moisture and adult emergence: a, *Haematobia irritans*; b, *Musca domestica*; c, *Cochliomyia americana*.

Twenty-three tests involving 2,300 pupae of *Cochliomyia americana* gave a high emergence of screwworm flies from soils containing less than 14 percent of water, and no flies emerged from soils containing in excess of 16.1 percent. The results of these tests verify frequent observations on the incidence of screwworms in Florida during the outbreak in 1935-36. These observations indicated that the moisture content of the soil had a direct influence on the relative abundance of these pests. During periods of heavy rainfall the screwworm infestations were most abundant in livestock on the high, well-drained soils and relatively scarce on the low, wet soils. Conversely, during the dry season screwworm cases were abundant on the low, poorly drained soils and comparatively scarce on the uplands. This may indicate that a dry soil, in nature, is a contributing factor in screwworm control even though the highest emergence in the laboratory was from pupae in a dry soil.

Sixteen tests with 1,600 pupae of *Musca domestica* gave results

similar to those obtained for *Cochliomyia americana*.

Seventeen tests with pupae of *Haematobia irritans* (50 in each jar) showed that soils containing less than 0.25 percent of moisture and soils of more than 14.5 percent inhibited the development of the pupae. The percentage of adult emergence was distinctly highest from soils containing approximately 7 percent of moisture. In nature, soil moisture has a definite effect upon the abundance of horn flies. It is common knowledge that horn flies are relatively scarce during periods of prolonged drought and that they increase in numbers rapidly after sufficient rainfall. The larvae, upon reaching maturity, pupate in the dung or in the soil, depending on which offers the more favorable moisture conditions. Ordinarily the larvae prefer to pupate in soil containing from 3.5 to 5 percent of moisture (by weight). Experience in raising thousands of horn flies under various conditions clearly demonstrates the susceptibility of horn fly pupae to unfavorable moisture conditions.

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SOME RECENT OBSERVATIONS ON THE ACTIVITIES OF
PHYLLOPHAGA LANCEOLATA SAY (SCARABAEIDAE)*

Harry R. Bryson, Asst. Entomologist, Kansas Agricultural Experiment Station**

The wheat white grub *Phyllophaga lanceolata* Say always has been prominent as a pest of wheat in south central Kansas. Hayes¹ (1919) called attention to the fact that the local distribution of the species differs rather markedly in extent in the northern and southern parts of the state. He found the distribution limited to the lowlands in the southern part of the state while the species was found more frequently on the higher prairie lands in the northern part.

Recent dry years, 1935-1938, apparently, have had an effect in extending the range of this pest farther north. Although it is known to occur in every county in the eastern one half of the state from the southern boundary to the northern one, reports of injury to wheat usually come only from the south central counties.

During 1937, reports of damage were received from counties as far north as Cloud county. Adults were abundant in wheat fields in Osborne county during the summer of 1938. This increase in abundance is in evidence on the higher prairie land in the vicinity of Manhattan. So long as the species confined its activities to high prairie lands used for pasture or meadow, the injury to the grass roots was not so noticeable, but when it became abundant on golf courses its activities began to attract attention.

While collecting the beetles of this species for the study of their parasites, the writer became interested, in 1937, in the apparent increase in population of the beetles over numbers occurring on a golf course during previous years. The beetles were more abundant during 1938 which was an even number year, and the one when the main brood of the beetles emerge. Because no regular collection records have been kept regarding the population of the beetles on the area year after year, it was not until 1937 that the possible effect of this increased population upon the sod was given much consideration.

The turf on this golf course, like many similar courses in central Kansas is composed of various species of prairie grasses. In the fairways are found those species which have survived close clipping and exposure to tramping and to the hot sun. Many of the plants remaining have been weakened by this treatment to the point where they are barely able to maintain themselves. This injury to the plants, accentuated by the damage done by the feeding activities of

*Contribution No. 472, Department of Entomology.

**This paper embodies observations recorded under wheat insect investigations supported by funds from Project No. 8 Hatch.

¹Hayes, Wm. P. The life cycle of *Lachnosterna lanceolata* Say. Jour. Econ. Ent. 12: 109-117. 1919.

the wheat white grub, has caused the sod to become broken so that weeds, especially dandelions, have become established. The dandelion plants, when subjected to constant clipping, assume a rosetted appearance and become so numerous that the surface of the soil is covered with a "mat" of leaves. Once these plants become established it is a difficult matter to eliminate them from the area as well as to reestablish the stand of grass.

The writer is of the opinion that the wheat white grub has been favored by these ecological conditions and has become a menace to the maintenance of the grass. The adult females, which are wingless, are forced to travel on foot wherever they go. This also supports the contention that the female beetles as well as the males were produced near where they are performing their various life activities.

Daily collections were made for a two weeks period during the summers of 1937 and 1938. Since this species is diurnal, collections were made in the fairways from 7:30 until 10:00 o'clock in the morning. As many as 339 beetles were collected during a single 2-hour period.

During this time of day, practically all the beetles, with few exceptions, were taken crawling about on the surface of the soil or on weeds which served as food plants. Two hundred eight of the 339 beetles collected were females. Observations indicated that the females were feeding consistently upon the leaves of the dandelion plants as well as upon those of other plants. At another time 400 beetles were collected near one green and one tee. Practically all of these were feeding upon the dense mat of dandelion leaves on this area. As many as 10-15 beetles were taken on one large rosetted plant.

As the temperature became higher during the morning, the beetles began to disappear from the surface of the fairways. While some of the beetles crawled into the rough others burrowed into the soil. Where dandelions were plentiful and where the females had been feeding upon the plants, they were observed to burrow in the soil directly beneath a single dandelion plant, covering an area 10 inches in diameter.

A few eggs were found at a depth of four inches but due to the fact that holes had to be dug in the fairways, it was not feasible to excavate to determine the number of eggs deposited on the areas. No excavations have been made to determine the population of the larvae present in the fairways with that to be found in the rough. Frequent examinations of the females collected each day showed that each female contained from 11 to 26 eggs. Since many pairs were observed in copula, the writer has every reason to believe that the females were depositing eggs on the area. Females retained in the insectary deposited fertile eggs which hatched. Both males and females were parasitized by *Sarcophagid* flies. Species of the flies

reared have not been determined. This parasitism may aid in reducing the number of larvae remaining to injure the sod.

SUMMARY

The foregoing observations indicate that the wheat white grub possesses potentialities as a pest of golf courses in Central Kansas. A cycle of ecological conditions may result in the perpetuation of the species on the areas and the grass may be greatly injured by its presence.

The larvae and close clipping tend to destroy the grass on the fairways. Dandelions grow on the denuded spots and furnish food for the females as well as a place under which they can burrow and deposit eggs to produce more larvae. The situation is one which will command careful consideration where the conservation of the turf has become a problem.



TWO NEW CORIXIDAE FROM BOLIVIA

H. B. Hungerford, Lawrence, Kansas*

*Sigara femoridens***Size:** Length 6.6 mm. Width across head 2.1 mm.

Color: General color slightly lighter than medium due to the fact that the pale bands of the pronotum and irregular figures of hemelytra are broader than the dark ones; the pronotum crossed by about ten brown bands, the median ones broken and overlapping. The brown figures of the hemelytra anastomosing to form a quite uniform reticulation. The base of clavus and the membranal suture slightly lighter in color. Head and limbs pale yellow, abdominal venter of males embrowned.

Structural Characteristics: Head of male approximately five-sevenths as long as pronotum, that of females less than half as long as pronotum. Face of male with broad oval depression not quite attaining inner angle of the eyes laterally. Pronotum faintly and hemelytra non-rastrate. Metaxyphus appearing a little longer than broad and bluntly pointed. The front leg of the male as shown in the drawing, the characteristic projection on the femur suggesting the name. The tarsal claws of the middle legs longer than the tarsi, which are shorter than the tibiae. The special features of male abdomen and genital capsule shown in the drawings.

Described from four males and two females from Cochabamba, Bolivia, South America.

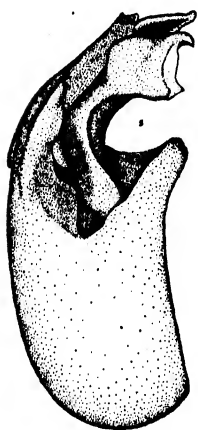
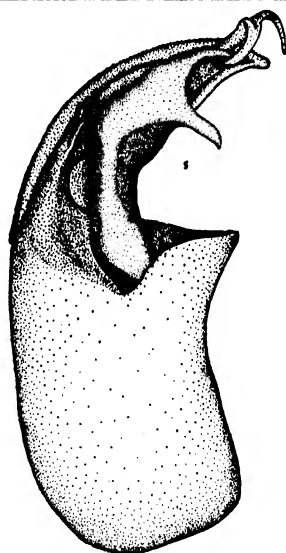
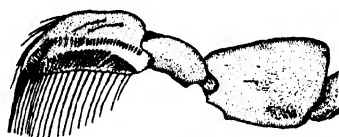
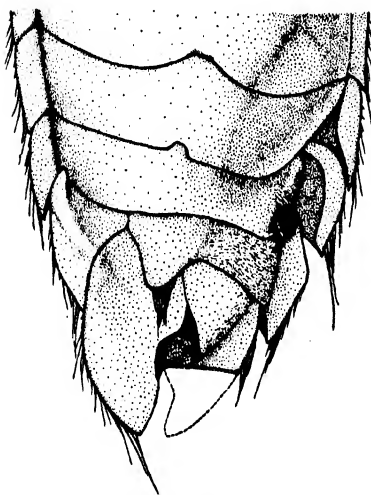
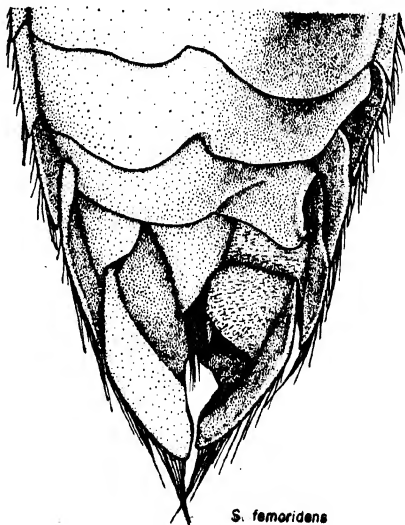
Comparative Notes: This species resembles *S. denseconscripta* (Breddin) in the shape of the male pala but is distinguished from that species by possessing a blunt projection on front femur, by the shape of the right clasper, and by the pigment pattern, which is more reticulate than in *S. denseconscripta* (Breddin).

Sigara boliviensis n. sp.**Size:** Length 6 mm. Width across head 1.95 mm.

Color: General facies of usual color, the pronotum crossed by about eight dark bands which on the whole are slightly narrower than the pale stripes. Hemelytra with the dark figures more or less anastomosing into reticulations faintly transverse in character. Head and legs pale yellow; venter more or less dark.

Structural Characteristics: Head of male as measured from above shorter than interocular space, and about half length of pronotum. Face of male with oval depression not provided above with a distinctly edged arch. Pronotum rastrate, base of clavus faintly rastrate. Lateral lobe of pronotum a little broader than in *S. dita* Jaczewski. Metaxyphus as long as broad and bluntly rounded at apex. The front leg of the male as shown in the drawing. Tarsal

*Contribution from the Department of Entomology, University of Kansas.

*S. boliviensis**S. femoridens**S. boliviensis**S. femoridens**S. boliviensis**S. femoridens*

claws of middle leg as long as the tibia, which is longer than the tarsus.

The special features of male abdomen and genital capsule shown in the drawing.

Location of Type: Described from single male holotype in the Francis Huntington Snow Collections, University of Kansas. The specimen comes from Colomi, Bolivia, South America.

Comparative Notes: This species is very close to *S. dita* Jaczewski, the marked variability of which has been shown by Dr. Jaczewski. It is a larger species, with a relatively broad interocular space. The lateral lobe of the pronotum is relatively broader, the strigil larger, the underside of hind femur not so extensively clothed with pile, the light colored figures of pronotum and hemelytra larger, the frontal depression of the head not marked by a projecting arch, the median pronotal carina less marked, and the metaxypus longer.



MINUTES OF THE 15TH ANNUAL MEETING
of the
KANSAS ENTOMOLOGICAL SOCIETY

University of Kansas, Lawrence, Kansas

APRIL 1, 1939

BUSINESS MEETING

President L. C. Woodruff called the meeting to order at 10:00 A. M. in Room 417, Snow Hall.

The minutes of the 14th annual meeting were read and approved.

REPORTS OF OFFICERS

The Secretary-Treasurer's report was read and approved, A summary of the report is as follows:

Receipts, April 1, 1938 to March 31, 1939	\$ 571.74
Disbursements, April 1, 1938 to March 31, 1939	311.83
	\$ 259.91
Assets: U. S. Savings Bonds, Maturity value \$850.00, \$	637.50
Balance in checking account	259.91
Accounts receivable	None
Liabilities	None
Net Assets, March 31, 1939	\$ 897.41

REPORT OF THE EDITOR OF THE JOURNAL

To date more than 200 articles have been printed in the Journal. Of this number, the subject matter was divided as follows:

Taxonomic papers	47 percent
Economic papers	28 percent
Insect Lists	12 percent
Insect Ecology	11 percent
Insect Physiology	1 percent
History of Entomology	1 percent

With regard to the origin of articles thus far printed in the Journal, the distribution was as follows:

Papers by members located at the Univ. of Kans.,	39 percent
Papers by members located at Kans. State Col.,	28 percent
Papers by members outside the State of Kans.,	33 percent

Sixty-two percent of the present membership have received complete files of the Journal.

On the whole the Journal is fulfilling its purpose, but there should be an improvement in the format of the Journal and a reduction in the price of reprints.

Editor's report was accepted.

Dr. Lawson moved that the Secretary be authorized to proceed with making new publishing arrangements for the Journal, beginning with the July, 1939 number.

Motion seconded and passed.

Dr. Lawson moved that hereafter the Journal be printed as follows:

The body of the text to be in 10-point type.

All keys, descriptions, footnotes to be in 8-point type, unless it be found advantageous to use 8-point leaded type throughout.

Motion seconded and passed.

Dr. Beamer moved that 25 separates be allowed to each author, provided that at least 25 additional separates are ordered; and further, that a price schedule for separates be set up by the Secretary to allow a sufficient profit to the Society to take care of running expenses.

Motion seconded and passed.

Dr. Parker moved that the Secretary be authorized to have printed approximately 50 extra copies of the Journal, over and above the regular subscription list.

Motion seconded and passed.

REPORT OF THE COMMITTEE ON WILD LIFE AND STATE PARKS

President Woodruff explained that inasmuch as the committee had been non-existent for some time, and that the Kansas Academy of Science has such a committee, it would seem proper to discontinue the Committee on Wild Life and State Parks.

Mr. Bryson moved that the Committee on Wild Life and State Parks be discontinued.

Motion seconded and passed.

APPOINTMENT OF COMMITTEES

President Woodruff appointed the following committees:

RESOLUTIONS: R. T. Cotton, D. B. Whelan, D. A. Wilbur.

NOMINATIONS: R. H. Beamer, R. H. Painter, W. T. Emery.

AUDITING: for 1939: B. E. Liston, M. W. Sanderson

AUDITING: for 1940: W. T. Emery, D. A. Wilbur.

OLD BUSINESS: None.

NEW BUSINESS: None.

Then followed the presentation of papers, the program consisting of 28 titles as follows:

Morning Session

1. Studies of some physical factors affecting the resistance of wheat to hessian fly attack. Elmer T. Jones, Bur. Ent. & Pl. Quar. Manhattan. (By title).

2. Some studies on the nesting habits of *Batazonus navus* Cresson. Robert E. Bugbee, College of Emporia.

3. The identification of the eggs of grasshoppers by the sculpturing on the chorion. J. B. Tuck, K. S. C.

4. Some additional grasshopper collection records. Roland W. Portman, K. S. C. (by title)

5. Recent notes on the activities of the beetles of *Phyllophaga lanceolata* (Scarabaeidae). H. R. Bryson, K. S. C.

6. Road crickets. R. H. Beamer, U. of K.

7. A question of synonymy. H. B. Hungerford, U. of K.

8. Labels and labeling insects. R. H. Painter. K. S. C.

Afternoon Session

9. Observations on subterranean termites attacking living plants. F. L. McDonald, K. S. C.

10. Notes on the dusky plant bug (*Adelphocoris rapidus* Say) as an economic pest. Chas Curtis, K. S. C.

11. Preliminary observations of *Crambus* in Kansas. H. D. O. Miller, K. S. C.

12. Effects of high soil and air temperatures on some alfalfa insects. Roger C. Smith, K. S. C.

13. A method of utilizing pyrethrum for greenhouse fumigation. R. H. Beatie, U. of K.

14. A consideration of the white-fringed beetle as a potential pest in Kansas. L. S. Henderson, U. of K.

15. Observations on Ozark cave beetles. M. W. Sanderson, U. of Ark.

16. The biology of the black blister beetle (*Epicauta pennsylvanica* Deg.). Wm. R. Horsfall. U. of Ark. (by title).

17. A revisional study on new world *Plectia* and *Penthetria*. D. Elmo Hardy, U. of Kans.

18. Factors influencing extra molts in the roach. Max Temple, U. of Kans.

19. The genus *Aligia* (Homoptera). L. W. Hepner, U. of Kans.

20. The systematic value of genitalia in the genus *Ormenis* (Homoptera). Chas. L. Shepard, U. of Kans.

21. A new pest of junipers. Edw. G. Wegenek, U. of Kans.

22. *Rhopalocera*, distributional notes for southwestern United States. Wm. D. Field, U. of Kans.

23. Notes on the distribution of the genus *Trichocorixa*. R. I. Sailer, U. of Kans.

24. Insects notes of the hickory borer and redbud aphid. R. L. Parker, K. S. C.

25. Folklore of poisonous arthropods of Mexico. L. J. Lipovsky, U. of Kans.

26. Final report on the mosquitoes of Kansas. Mrs. Noblesse De Moss Hill. (by title).

27. Adjusting insect control conservation practices. Don B. Whelan, U. of Nebr.

28. The role of plastics in the field of entomology. Don B. Whelan, U. of Nebr.

FINAL BUSINESS**AUDITING COMMITTEE:**

The treasurer's accounts for the period April 1, 1938 to March 31, 1939 have been audited this 1st day of April, 1939, and found to be in order.

(Signed): B. E. Liston, M.W. Sanderson

Motion made and seconded to accept the report of the auditing committee.

Motion carried

RESOLUTIONS COMMITTEE:

Whereas, the University of Kansas, the Kansas Academy of Science, and the Department of Entomology of the University of Kansas have all cooperated in making the meeting of this Society a success

Be it resolved that the thanks and appreciation of the Society be extended to the members of the local committee, Kansas University, and the Department of Entomology of the University of Kansas, for the excellent arrangements made for our comfort and for the facilities provided for holding these meetings.

Be it further resolved that the Kansas Entomological Society express their appreciation of the efforts of the Secretary-Treasurer during the past year in conducting the business of the Society and in the business management of the Journal, and furthermore, that the thanks of the Society be expressed to the Editor of the Journal for the excellent manner in which he has conducted this publication during the year.

(Signed): R. T. Cotton, D. B. Whelan, D. A. Wilbur.

Motion made, seconded, and carried to accept as a whole the report of the Resolutions committee.

NOMINATIONS COMMITTEE:

The committee placed in nomination the following members for officers for the coming year:

For President: R. T. Cotton

For Vice-president: R. L. Parker.

For Secretary-Treasurer: H. H. Walkden.

(Signed): R. H. Beamer, R. H. Painter, W. T. Emery.

Mr. Painter moved that the Secretary cast a unanimous vote for these officers. Motion seconded and passed.

It was voted that the Executive committee select the time and place of the next annual meeting.

Mr. Whelan suggested that the 1940 meeting be held in Topeka, Kansas, in lieu of meeting with the Kansas Academy of Science in Wichita, if, in the opinion of the Executive committee this is desirable.

Adjournment was at 5:00 P. M.

There were 65 members and friends in attendance, from Lawrence, Manhattan, Ottawa, McPherson, Emporia, Topeka and Coffeyville in Kansas, and from Fayetteville, Ark., Lincoln, Nebr., and Kansas City, Mo.

H. H. Walkden, Secretary-Treasurer.

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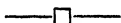
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CONTENTS OF THIS NUMBER

Some Factors Influencing the Number of Molts of the German Roach, Lois Seamans and Laurence C. Woodruff	73
Mass Flights of the Pentatomid, <i>Thyanta custator</i> (Fabr.), In Kansas, Donald A. Wilbur	77
The Genus <i>Calana</i> DeL. (Homotera Cicadellidae), R. H. Beamer	81
Three New Dolichopodidae, F. C. Harmston and G. F. Knowlton	83
Some Notes on the Nesting Habits of <i>Batazonus navus</i> Cresson, Robert E. Bugbee	87
Some Observations on Insect Edaphology, W. G. Bruce.....	91
Some Recent Observations on the Activities of <i>Phyllophaga lanceolata</i> Say (Scarabaeidae), Harry R. Bryson	94
Two New Corixidae from Bolivia, H. B. Hungerford.....	97
Minutes of the 15th Annual Meeting, H. H. Walkden, Sec'y	100

JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY



A quarterly journal published in January, April, July and October devoted to Entomology in the Western Mississippi Basin and the proceedings of the Kansas Entomological Society.

Manuscripts for publication may be sent to any of the publication committee.

The Kansas Entomological Society does not make exchanges since the Society does not maintain a library.

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Volume 12, No. 3, July, 1939

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NO. 4

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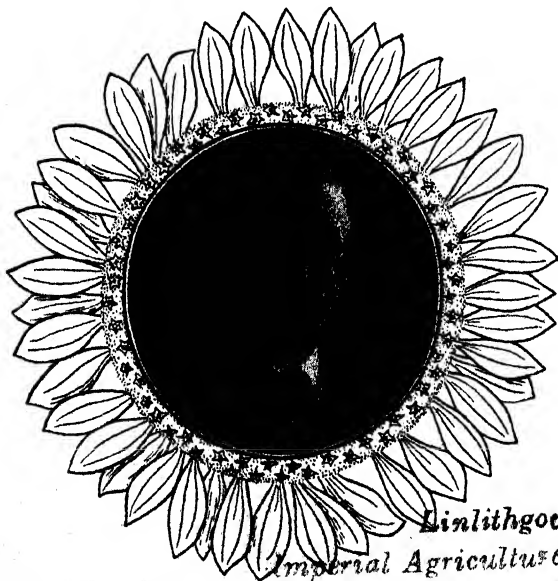
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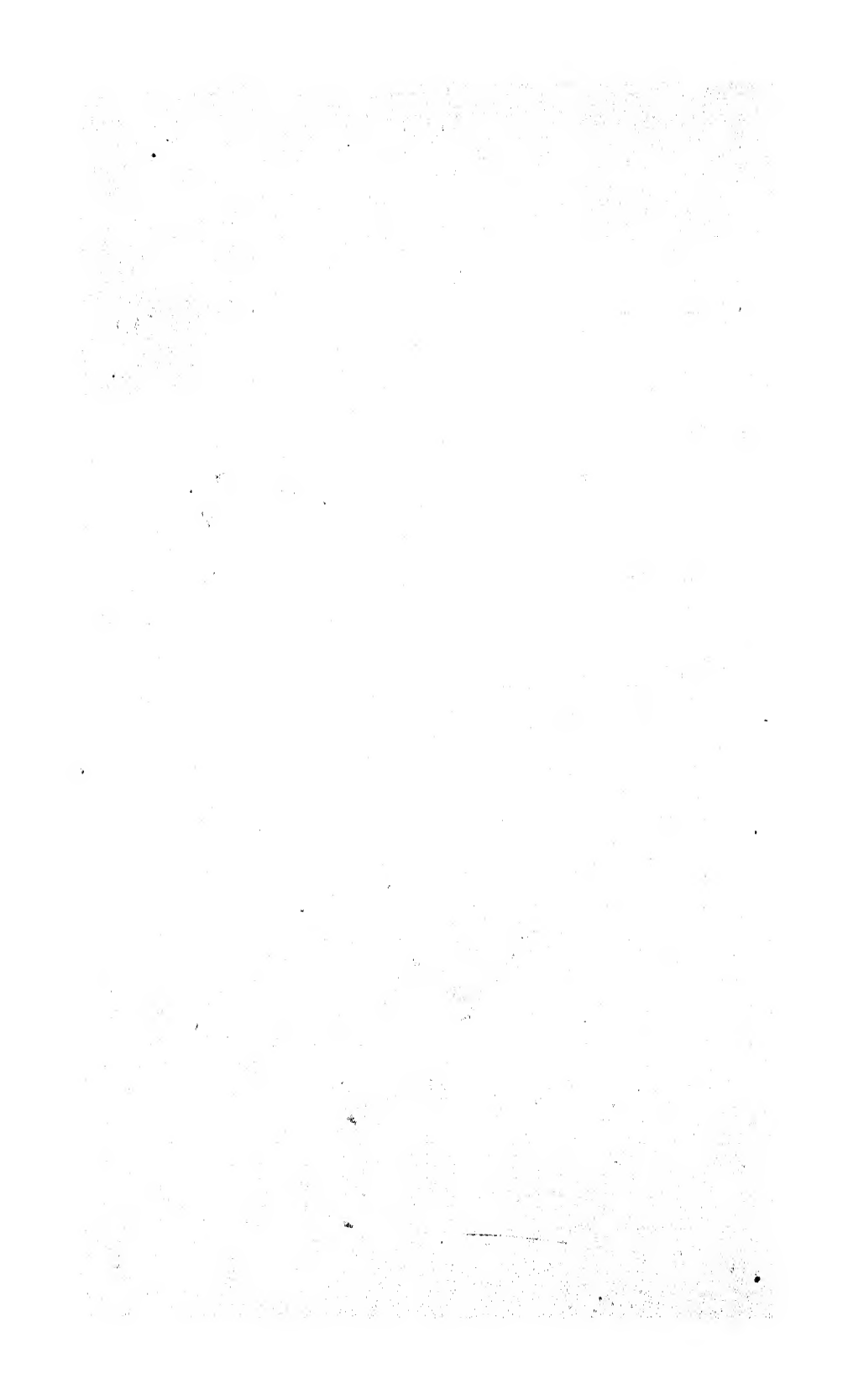
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Kansas Entomological Society

Vol. 12, No. 4

October, 1939

NEW SPECIES OF ALIGIA (HOMOPTERA CICADELLIDAE)

Leon Hepner, Lawrence, Kansas*

Aligia dellana suffusca n. sub sp.

Resembles *dellana* but usually darker with the aedeagus of the males somewhat longer. Length: male 4 mm., female 4.5 mm.

Vertex rounded, almost parallel margined, much wider between eyes than length at middle, transverse furrow almost absent. Cross-veins in tegmen few in number.

Color: Female with vertex and scutellum white to brown, with typical markings sometimes evident, pronotum darker. Tegmen semihyaline to white with two crossbands yellow to brown, veins darkening posteriorly. Males with vertex and scutellum yellow to brown with typical markings seldom evident. Tegmen light brown to fuscous excepting few spots semihyaline to white in a band across second cross nervure and in region of anteapical cells and two or three fuscous spots in clavus. Veins darkening posteriorly.

Genitalia: Pygofer somewhat more oval and shorter than *dellana*, about three-fourths as wide at constriction as distance from there to apex; pygofer hook extending to apex of pygofer, twisted near middle, almost parallel-sided to outer fifth with short, sharp, recurved process on dorsal margin near apex. Aedeagus in lateral view longer than *dellana*, about five times as long as basal width, curved strongly on basal third, narrowing gradually to less than one-half basal width at middle, almost parallel margined to apex; in ventral view parallel sided, bifurcate on outer fourth and bearing a pair of lateral processes about one-third length of shaft of aedeagus. Styles about three times as long as basal width, sinuately narrowed to one-fifth basal width on outer fourth, apices bluntly pointed.

Types: Holotype male, allotype female, and 5 female and 2 male paratypes, Arroyo Seco River, Calif., Aug. 8, 1939, R. H. Beamer in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Other paratypes as follows: 4 females, Arroyo Seco River, Calif., Aug. 8, 1938, L. W. Hepner; 1 male, R. I. Sailer; 8 females, 5 males, Santa Rosa, Calif., Aug. 16, 1938, R. H. Beamer; 5 females, 4 males, L. W. Hepner; 1 male, Dulzura, Calif., Aug. 9, 1935, R. H. Beamer; 1 female, 3 males, Lockwood, Calif., July 24, 1935, R. H. Beamer; 2 females, 1 male, Idyllwild, Calif., Aug. 3, 1935, R. H. Beamer; 17 females, 2 males, Topango Canyon, Calif., Aug. 5, 1938, R. H. Beamer, 1 female, L. W. Hepner; 12 females, 2 males, Red Bluffs, Calif., June 27, 1935, R. H. Beamer; 17 females, 8 males, Sonora, Calif., July 11, 1933, R. H. Beamer; 2 females, Redding Calif., June 28, 1935, R. H. Beamer, 5 females, 1 male, P. W. Oman; 4 females, 2 males, Cajon Pass, Calif., Aug. 6, 1936, R. H. Beamer; 3 females, Clayton, Calif., July 20, 1935, R. H. Beamer;

*Contribution from the Department of Entomology, University of Kansas

2 females, Lemon Cove, Calif., July 26, 1929, R. H. Beamer; 1 female, Delta, Calif., June 28, 1935, R. H. Beamer; 1 female, Bowman, Calif., July 20, 1938, L. W. Hepner; 1 female, Alameda, Co., Calif., July 19, 1933, Jean Russell; 2 females, Three Rivers, Calif., July 8, 1932, R. H. Beamer, 3 males, June 9, 1935, P. W. Oman; 1 male, Pasadena, Calif., July 12, 1931, E. D. Ball; 1 female, Mint Canyon, Calif., July 7, 1933, R. H. Beamer; 7 females, Paynes Creek, Calif., June 27, 1935, P. W. Oman; 1 male, Lompoc, Calif., Aug. 6, 1938, L. W. Hepner; 1 female, Santa Cruz Mts., Calif., Aug. 13, 1938, L. W. Hepner.

Aligia pallida n. sp.

Resembles *dellana* but almost without darker markings and male with double pygofer hook. Length: male 4.5 mm., female 5 mm.

Vertex rounded, almost parallel margined, about three times as wide between eyes as length at middle, transverse furrow very shallow; cross-veins usually few in number.

Genitalia: Pygofer triangular, about as wide at constriction as length from there to apex; pygofer hook bifid, dorsal fork extending slightly beyond apex of pygofer, broadening to truncate apex, ventral fork almost as long, widening on outer half, usually bifid at apex. Aedeagus in lateral view about three times as long as basal width, almost parallel margined to outer fifth, widening suddenly on dorsal margin, apex triangular; in ventral view, narrow, parallel sided, bifurcate about one-fifth length of aedeagus and bearing a pair of lateral processes about one-third length of shaft of aedeagus. Styles over twice as long as basal width, sinuately narrowed to outer third with blunt apices.

Types: Holotype female, allotype female, Santa Rita Mts., Ariz., July 17, 1932, R. H. Beamer in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Paratypes as follows: 1 female, Santa Rita Mts., Ariz., June 12, 1932, P. W. Oman, 1 female, June 22, 1930, E. D. Ball; 1 male, Chiricahua Mts., Ariz., July 14, 1938, R. H. Beamer, 1 female, July 5, 1930, E. D. Ball; 3 females, 1 male, Granite Dell, Ariz., July 30, 1933, R. H. Beamer, 1 female, Aug. 14, 1935, R. H. Beamer, 1 female, 1 male, May 30, 1935, P. W. Oman, 1 male, 2 females, July 17, 1929, E. D. Ball; 1 female, Tumacacori Mts., Ariz., July 22, 1938, R. H. Beamer; 1 female, Nogales, Ariz., June 25, 1933, R. H. Beamer; 1 male, Miami, Ariz., July 22, 1932, R. H. Beamer; 1 female, Tuscon, Ariz., June 9, 1929, E. D. Ball, 1 male, May 16, 1929, E. D. Ball; 1 male, Patagonia, Ariz., Sept. 7, 1929, E. D. Ball; 2 females, Huachuca Mts., Ariz., June 15, 1930, E. D. Ball.

Specimens that were collected in May and early June were much darker, with heavier and more numerous veins, evidently representing the over-wintering adults.

Aligia lutea n. sp.

Resembles *pallida* but more colorful, usually with cross-veins more numerous, with aedeagus broader and bearing a pair of extremely short lateral processes, and ventral fork of pygofer hook never bifid. Length: Male 4.5 mm., female 5 mm.

Vertex rounded, about two and one-half times as wide between

eyes as length at middle, transverse furrow very shallow; cross-veins in tegmen, although rather inconspicuous, are numerous throughout.

Color: Tawny throughout with typical markings sometimes faintly indicated, pronotum somewhat darker. Tegmen semihyaline, more or less suffused with tawny.

Genitalia: Pygofer triangular, about four-fifths as wide at constriction as length from there to apex; pygofer hook bifid, dorsal fork extending almost to apex, slender, widest on outer two-thirds, apex sharp; ventral fork about two-thirds as long, apex sharp. Aedeagus broad in lateral view, about twice as long as basal width, almost parallel sided and bifurcate on about outer fourth. Styles about two and one-half times basal width, sinuately narrowed to outer fifth, apices sharp.

Types: Holotype male, allotype female, Santa Rita Mts., Ariz., July 17, 1932, R. H. Beamer, in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Paratypes as follows: 1 female, Santa Rita Mts., Ariz., June 12, 1932, P. W. Oman; 3 females, Granite Dell, Ariz., July 30, 1933, R. H. Beamer. 1 female, July 14, 1935, R. H. Beamer, 2 females, 1 male, May 30, 1935, P. W. Oman, 3 females, July 17, 1929, E. D. Ball; 1 female, Yarnell, Ariz., June 29, 1933, P. W. Oman.

As in *pallida*, specimens collected early in the year are darker and more heavily veined than others.

Aligia chiricana alta n. sub sp.

Resembling *chiricana*, but slightly larger, with a sharper vertex and with pronotum greenish-yellow; males same as females. Length male 4.2 mm., female 5 mm.

Vertex slightly more produced at tip than *chiricana*, two and one-half times as wide between eyes as length at middle, transverse furrow shallow; cross-veins in tegmen few in number, three or four in costa and one or two in center apical cell.

Genitalia: Resembles *chiricana* but larger with the aedeagus slightly longer. Pygofer acute, longer than width at constriction; pygofer hook bifid, dorsal fork ending just before apex, widest at middle, tapering to a rather sharp point, ventral one about two-thirds as long, slightly more slender. Aedeagus in lateral view long and slender, narrowest on outer fourth, enlarged to about twice basal width, apex rounded; in ventral view, bifurcate on outer fourth and bearing a pair of lateral processes about one-sixth as long as shaft of aedeagus. Styles about two and one-half times as long as basal width, sinuately narrowing to a rather blunt apex.

Types: Holotype male, allotype female, and one female paratype, Chiricahua Mts., Ariz., July 14, 1938, R. H. Beamer, in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Additional paratypes as follows: 1 female, 1 male, Chiricahua Mts., July 14, 1938, L. W. Hepner. 1 female. 8 males, July 8, 1932, R. H. Beamer, 1 female, July 26, 1937, D. J. and J. N. Knull.

Aligia meridiana n. sp.

Similar to *modesta* but more highly colored and with the male pygofer truncate at apex. Length: male 4.5 mm., female 5.5 mm.

Vertex rounded, almost parallel margined, about three times as wide between eyes as length at middle, transverse furrow shallow. Veins in tegmen distinct on outer half, cross-veins fairly numerous in corium.

Color: Vertex, pronotum and scutellum yellow-brown to orange, indications of typical markings usually present, face and clypeus yellow, sometimes with indications of dashes on clypeus. Tegmen of female semihyaline to white, with two reddish-brown crossbands separated by a light band about as wide as either, males similar, except that anterior band covers entire basal half of tegmen, veins of both always tawny, apical cells more or less infuscated.

Genitalia: Pygofer broad, wider on outer third than at constriction; pygofer hook extended beyond apex of pygofer, widest at base, almost parallel margined on outer three-fourths, apex sharp. Aedeagus broad in lateral view, a little more than twice as long as basal width, slightly narrowed from base to rounded apex; in ventral view, parallel sided, bifurcate on outer fifth and bearing a pair of lateral processes about one-half as long as shaft. Styles about three times as long as basal width, narrowed gradually to one-half basal width at middle, then both sides converging near outer sixth to about one-sixth basal width, apices strongly curved dorsally.

Types: Holotype male, allotype female, Fulton, Miss., July 14, 1930, L. D. Tuthill, in Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Paratypes as follows: 1 female, Meridian, Mississippi, July 17, 1930, P. W. Oman; 2 males, Fulton, Miss., July 14, 1930, R. H. Beamer; 1 male Iuka, Miss., July 14, 1930, R. H. Beamer; 2 males, Jefferson, Texas, June 21, 1938, R. H. Beamer; 1 male, Leavenworth, Kansas, June 30, 1924, E. P. Breakey; Coffeyville, Kansas, June 30, 1939, 3 males, L. W. Hepner; July 1, 1939, 7 males, 1 female; July 4, 1939, 7 males, 1 female; July 11, 1939, 3 males, 7 females; July 16, 1939, 2 males, 8 females; July 21, 1939, 13 females and July 25, 1939, 1 female.

Aligia bifurcata n. sp.

Resembles *magna* but smaller, tawny and without a semblance of a crossband. Length: male 5 mm., female 5.5 mm.

Vertex almost parallel margined, three to four times as wide between eyes as length at middle, transverse furrow shallow; numerous cross-veins throughout tegmen.

Color: Vertex and scutellum ivory yellow to light brown with typical markings somewhat darker, pronotum more or less irrorate with dark. Tegmen semihyaline to white, more or less suffused with tawny, veins darker, apical cells partly infuscated.

Genitalia: Pygofer more or less oval, about one and one-fourth times as long as width at constriction; pygofer hook bifid, dorsal fork

extending slightly beyond apex of pygofer, apex pointed, ventral fork about two-thirds length of dorsal, one-third wider, widest on outer third, apex pointed. Aedeagus in lateral view broad, about twice as long as basal width, sides almost parallel, narrowest on outer third, a pair of dorsal teeth just beyond, apex angular; in ventral view, bifurcate on outer third and bearing a pair of short lateral processes. Styles about twice as long as basal width, sinuately narrowed to outer sixth, apices sharp and curved.

Types: Holotype male, Huachuca Mts., Ariz., June 11, 1933, P. W. Oman, in the National Museum, Washington, D. C.; allotype female, Chiricahua Mts., Ariz., July 14, 1938, R. H. Beamer, in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Paratypes as follows: 3 females, Chiricahua Mts., Ariz., July 14, 1938, R. H. Beamer; 1 female, Huachuca Mts., Ariz., July 8, 1932, R. H. Beamer; 2 females, Glenn Oaks, Ariz., July 19, 1929, E. D. Ball.

Aligia acutata n. sp.

Resembles *magna* but smaller and more slender with a slender aedeagus without lateral processes and with forks of pygofer hook slender. Length: Male 5 mm., female 6 mm.

Vertex produced, about two and one-half times as wide between eyes as length at middle, transverse furrow prominent. Tegmen long with many cross-veins throughout.

Color: Vertex ivory yellow with two pairs of dark dots along anterior margin, a dark line along transverse furrow and a pair of lighter dots inside each eye. Pronotum grey flecked with fuscous except for a median longitudinal vitta and oftentimes a similar vitta on each side. Scutellum ivory yellow to light brown with typical markings darker. Tegmen semihyaline to white without any indication of a crossband, apical cells mostly fumose.

Genitalia: Pygofer acutely pointed at apex, broadly rounding on ventral margin, three-fourths as wide at constriction as length from there to apex; pygofer hook bifid, dorsal fork somewhat longer than pygofer, broadest at middle, apex sharp, ventral fork almost half as long as dorsal, very slender and almost parallel margined to sharp apex. Aedeagus in lateral view about five times basal width, slightly enlarged on dorsal margin near middle, dorsal teeth prominent, apex oval; in ventral view parallel sided and bifurcate on outer fifth. Styles slender, somewhat over twice as long as basal width, sinuately narrowed to outer fourth, apices long, slender and sharply pointed.

Types: Holotype male, allotype female and six female and two male paratypes, Huachuca Mts., Ariz., July 18, 1938, R. H. Beamer, in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Additional paratypes as follows: 2 females, 1 male, Huachuca Mts., Ariz., Aug. 22, 1935, R. H. Beamer, 2 females, 2 males, Oct. 31, 1937, P. W. Oman, 1 female, Aug. 2, 1927, R. H. Beamer; 5 females, 3 males, Chiricahua Mts., Ariz., July

14, 1938, R. H. Beamer, 2 females, 1 male, July 8, 1932, R. H. Beamer, 1 male, July 8, 1932, J. D. Beamer, 1 male, July 5, 1930, E. D. Ball, 1 female, July 14, 1938, L. W. Hepner, 1 male, June 9, 1933, R. H. Beamer; 2 females, Chiricahua National Monument, Ariz., Aug. 24, 1935, Jean Russell, 1 female, R. H. Beamer; 1 male, Santa Rita Mts., Ariz., July 17, 1932, R. H. Beamer, 1 female, 2 males, June 16, 1936, P. W. Oman, 1 female, 6 males, June 22, 1930, E. D. Ball, 2 females, Aug. 18, 1935, R. H. Beamer; 2 males, Tuscon, Ariz., Sept. 29, 1929, E. D. Ball, 1 male, Sept. 1, 1929, E. D. Ball, 1 female, 1 male, June 30, 1929, E. D. Ball.

Aligia pallidinota n. sp.

Resembles *inscripta* but with vertex, pronotum and scutellum light colored. Length male 5 mm., female 5.5 mm.

Vertex twice as wide between eyes as length at middle, produced in right angle to a more or less sharp tip, transverse furrow shallow. Veins in tegmen numerous on costa, in middle anteapical cells and on corium next clavus.

Color: Vertex and scutellum ivory white, a semblance of markings sometimes present; pronotum more or less mottled with grey, an indication of a pair of median longitudinal darker vittae; face, clypeus and margins of lorae fuscous, darker than *inscripta*. Tegmen semihyaline to white with two fuscous crossbands, light area between about half as wide as either, apical cells at least partly infuscated.

Genitalia: Pygofer more rounded than in *inscripta*, with apex blunter and fold along dorsal margin narrower; pygofer hook bifid, dorsal fork about twice as long as ventral, almost parallel with it on outer two-thirds, both about same width throughout. Aedeagus in lateral view about three times as long as basal width, narrowed evenly to one-third basal width just beyond middle, suddenly broadening to one-half basal width and tapering to blunt point; in ventral view, narrow, parallel sided, apex bifurcate one-third length of shaft of aedeagus. Styles more than twice as long as width at base, gradually narrowing to slightly over one-half basal width, constricting suddenly to one-fifth basal width, ventral margins curved to sharp apex.

Holotype male, allotype female and two female paratypes, Lompoc, Calif., Aug 9, 1938, R. H. Beamer, in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Additional paratypes as follows: 4 females, 1 male. Lompoc, Calif., Aug. 9. 1938. L. W. Hepner, 1 female. 3 males. R. I. Sailer; 2 females, 1 male. Dulzura, Calif., Aug. 9, 1935, R. H. Beamer.

The specimens from Dulzura are much lighter than those from the type locality, the dark areas of the tegmen being replaced by pale brown and the markings on the vertex being hardly visible.

Aligia obesa n. sp.

Resembles *bifasciata* but smaller with a shallower transverse furrow and with tegmen decidedly narrower at apex. Length: male 4 mm., female 5 mm.

Vertex round, almost parallel margined, about four times as wide between eyes as length at middle, transverse furrow shallow. Tegmen less flaring than either *munda* or *bifasciata*, distinctly narrower from tip of clavus to apex and closely appressed, giving the species a very narrow appearance posteriorly, cross-veins numerous throughout.

Color: Eyes red, vertex and scutellum ivory white to very pale brown, typical markings usually present, but light, pronotum more or less mottled with fuscous. Tegmen semihyaline to white with two brown crossbands, light area between about half as wide as either, veins brown, apical cells at least partly infuscated.

Genitalia: Pygofer oval, apex broadly rounded, about as wide at constriction as distance from there to apex; pygofer hook bifid, forks about equal in length, dorsal one about twice width of ventral, forks almost parallel along most of their length. Aedeagus in lateral view between four and five times as long as basal width, narrowing gradually to one-half basal width at middle, slightly enlarged on dorsal margin just before bluntly pointed apex. Styles twice as long as basal width, slightly narrowed at middle, three-fourths basal width near outer fourth, suddenly narrowed to one-sixth basal width, finger-like process of apex parallel sided and curved.

Types: Holotype male, allotype female, Ozona, Tex., July 9, 1936, R. H. Beamer, in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Paratypes as follows: 1 female, Tucumcari, N. M., June 25, 1932, R. H. Beamer; 2 females, Concan, Texas, June 4, 1933, P. W. Oman.

Aligia rotunda n. sp.

Resembles *bifasciata*, but smaller with ventral fork of pygofer hook not greatly enlarged at base, Tegmen not narrowed at apex as in *obesa*. Length: male 4 mm., female 5 mm.

Vertex almost parallel margined, decidedly wider between eyes than length at middle, transverse furrow prominent. Venation as in *bifasciata*, with many cross veins.

Color: Eyes red, vertex and scutellum dull yellow with typical markings fulvous, pronotum darker, more or less marked with fuscous. Tegmen semihyaline to white with two dark bands, one anterior and one posterior to second cross nervure, veins dark, apical cells partly infuscated.

Genitalia: Pygofer almost round, slightly longer than width at constriction; pygofer hook bifid, forks about equal in length, extending to margin of pygofer with dorsal one about half as thick as ventral. Aedeagus in lateral view long, narrowest at middle, widest at base and on apical fourth, apex rather sharp. Styles more than twice as long as basal width, sinuately narrowing to outer fourth, apices curved and bluntly pointed.

Types: Holotype male, allotype female and one female paratype, Tombstone, Ariz., July 16, 1936, E. D. Ball, in the E. D. Ball, collection, Tuscon, Ariz. Additional paratypes as follows: 2 male paratypes, Tombstone, Ariz., June 8, E. D. Ball.

This species might be confused with *oculea*, but has a great many more cross veins and differs greatly in the internal genitalia.

Aligia bifasciata n. sp.

Resembles *munda* but slightly smaller, darker, with a shorter vertex and aedeagus in lateral view widest beyond middle. Length: male 4.75 mm., female 5.5 mm.

Vertex almost parallel margined, about four times as wide between eyes as length at middle, transverse furrow prominent. Numerous cross-veins throughout tegmen as in *munda*.

Color: Vertex light brown, a pair of black dots at apex, another pair near ocelli, a much lighter pair just inside each eye, transverse furrow dark. Pronotum irrorate with fuscous, a pale longitudinal median line indicated. Scutellum light, except a large spot in each basal angle, a pair of small dots between these, a transverse line near apex, and a median line, darker. Tegmen semihyaline to white with two fuscous crossbands, light area between about half as wide as either; apical cells at least partly infuscated.

Genitalia: Pygofer rounded, slightly longer than width at constriction, folded along ventral margin; pygofer hook bifid, forks almost equal in length, dorsal one more slender, ventral one enlarged on basal two-fifths. Aedeagus in lateral view very long, eight times basal width, narrowest next base, widest near outer third, narrowing gradually to blunt apex. Styles more than twice as long as width at base, narrowing gradually to one-half basal width at middle, slightly enlarged on outer fifth, converging suddenly to slender, curved pointed apices.

Types: Holotype male, allotype female and 1 pair of paratypes, Chiricahua Mts., Ariz., July 14, 1938, R. H. Beamer, in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Additional paratypes as follows: 1 female, Ruby Ariz., July 22, 1938, R. H. Beamer; 1 female, Santa Rita Mts., Ariz., Aug. 18, 1935, R. H. Beamer, 1 male, June 27, 1933, P. W. Oman, 1 female, June 16, 1933, P. W. Oman, 1 female, June 12, 1933, P. W. Oman; 2 males, Tuscon, Ariz., Oct. 20, 1929, E. D. Ball.

Aligia reticulata n. sp.

Resembles *descripta*, but with margins of vertex almost parallel, aedeagus short and wide in lateral view, and dorsal fork of pygofer hook broad at apex. Length: male 4.2 mm., female 5 mm.

Vertex almost parallel margined, about three times as wide between eyes as length at middle, transverse furrow prominent. Cross veins numerous throughout tegmen.

Color: Clypeus, anteclypeus, lorae and cheeks ivory yellow with typical markings fuscous, pronotum more or less mottled with

fuscous, scutellum light with apex and basal angles darker. Tegmen semihyaline to white, with sometimes a faint indication of cross-band, veins dark, apical cells often slightly infuscated.

Genitalia: Pygofer oval, somewhat narrower at constriction than distance from there to apex; pygofer hook bifid, dorsal fork extending slightly beyond apex of pygofer, broadening on outer two-thirds to truncate apex; ventral fork short and about as wide as narrowest point of dorsal. Aedeagus in lateral view broad and short, about twice as long as basal width, broadest at base, tapering from there to a pair of short teeth on dorsal margin one-fourth distance from tip, apex triangular; in ventral view, bifurcate on outer fourth and bearing a pair of short lateral processes. Styles about twice as long as basal width, sinuately converging from base, apex sharp.

Types: Holotype male, allotype female, and one pair of paratypes, Miami, Ariz., July 22, 1932, R. H. Beamer, in the Francis Huntington Snow Museum, University of Kansas, Lawrence, Kansas. Additional paratypes as follows: 2 females, 1 male, Yarnell Heights, Ariz., June 29, 1933, P. W. Oman; 1 female, Yavapai Co., Ariz., July 1, 1929, R. H. Beamer; 1 female, Granite Dell, Ariz., July 30, 1933, R. H. Beamer; 2 females, Nogales, Ariz., July 25, 1933, R. H. Beamer; 2 females, Santa Rita Mts., Ariz., July, F. H. Snow, 1 female, May 30, 1920, E. D. Ball; 1 female, Tuscon, Ariz., June 16, 1933, 1 female, Oct. 20, 1929, E. D. Ball, 1 female, May 16, 1929, E. D. Ball.

Aligia atrivena n. sp.

Resembles *jucunda* but larger, darker and with more reticulations in tegmen. Length: male 5 mm., female 5.75 mm.

Vertex slightly produced, about three and one-half times as wide between eyes as length at middle, transverse furrow prominent.

Color: Vertex and scutellum ivory white to light yellow, with typical markings dark and distinct; pronotum gray more or less irrorate with fuscous with three pairs of dark spots along the anterior margin distinct. Tegmen semihyaline to white with veins fuscous, faint indication of crossbands sometimes present, apical cells partly infuscated.

Genitalia: Pygofer slender, rounded at apex, about one and one-fourth times as long as width at constriction; pygofer hook falcate, bent into right angle near base, distinctly widest near outer third, tapering to long sharp point. Aedeagus in lateral view long, bent dorsally in right angle near base, sides parallel to outer fourth, abruptly enlarged to large knob-like apex; in ventral view parallel margined, bifurcate on outer fifth and bearing a pair of lateral appendages about one-fifth as long as length of shaft. Styles about twice basal width, sinuately narrowed to outer fifth, apices curved and pointed.

Types: Holotype male, allotype female and 2 male paratypes, Yarnell, Ariz., July 29, 1933, R. H. Beamer, in the Francis Huntington Snow Museum, University of Kansas, Lawrence, Kansas. Additional paratypes as follows: 3 females, 3 males, July 25, 1932, R.

H. Beamer, 15 females, 5 males, June 29, 1933, P. W. Oman; 1 female, 1 male, Yavapai Co., Ariz., Aug. 9, 1927, R. H. Beamer; 1 female, Colfax Co., N. M., Aug. 21, 1927, R. H. Beamer; 1 female, Luna, N. M., July 25, 1936, R. H. Beamer; 1 female, Silver City, N. M., July 22, 1936, D. R. Lindsay, 1 female, July 23, 1936, R. H. Beamer; 1 male, Cloudcroft, N. M., June 30, 1932, R. H. Beamer; 1 male, Durango, Colo., July 6, 1937, R. H. Beamer; 2 males, Granite Dell, Ariz., May 30, 1935, P. W. Oman; 2 females, 3 males, Mayhill, N. M., June 7, 1933, P. W. Oman.

Aligia magna n. sp.

Resembles *munda* but slightly larger, darker and with a less angular vertex and with ventral fork of pygofer hook much enlarged on outer third; aedeagus with lateral processes. Length: male 4.2 mm., female 5 mm.

Vertex slightly angled, about two and one-half times as wide between eyes as length at middle, transverse furrow prominent; tegmen long, broadest on basal fifth, many cross veins throughout.

Color: Vertex and scutellum ivory to white with typical markings fulvous, pronotum more or less irrorate with fuscous. Tegmen semihyaline to white with fuscous markings darker, cross-bands usually faintly evident, veins dark.

Genitalia: Pygofer triangular, broadly rounded on ventral margin, almost as wide at constriction as distance from there to apex; pygofer hook bifid, dorsal fork extending about to apex of pygofer, broadest on apical half, irregularly notched on ventral margin and sharply pointed, ventral fork slightly over one-half as long, enlarged to twice basal width on outer fourth. Aedeagus in lateral view slender, about three times as long as basal width, narrowest on outer fourth, apical dorsal teeth about as long as width of shaft at narrowest point, apex oval; in ventral view slender, parallel margined, bifurcate on outer fourth and bearing a pair of short, erect processes one-third length of shaft of aedeagus from apex. Styles about twice as long as basal width, sinuately narrowed to a typical apex.

Types: Holotype male, allotype female and 20 female and 6 male paratypes, Huachuca Mts., Ariz., July 18, 1938, R. H. Beamer. in the Francis Huntington Snow Entomological Museum, University of Kansas. Lawrence, Kansas. Additional paratypes as follows: 2 females, Huachaca Mts., Ariz., Aug. 22, 1935, R. H. Beamer; 2 females, June 11, 1933, R. H. Beamer, 4 females, Oct. 30, 1937, P. W. Oman, 2 males, June 15, 1930, E. D. Ball, 2 females Aug. 2, 1931, E. D. Ball; 15 females, Chiricahua National Monument, Aug. 24, 1935, R. H. Beamer; 7 females, Jack Beamer, 5 females, Jean Russell; 2 females, 1 male, Chiricahua Mts., Ariz., July 14, 1938, R. H. Beamer, 1 male, July 14, 1938, R. I. Sailer, 1 male, July 8, 1932, J. D. Beamer.

Afigia obtusa n. sp.

Resembling *jucunda*, but slightly larger, darker, with a broader, shorter vertex and with pygofer hook much broader on outer half. Length: male 4.5 mm., female 5.25 mm.

Vertex rounded, parallel margined, about four times as wide between eyes as length at middle, transverse furrow very shallow.

Tegmen less flaring than normal with a moderate number of cross-veins.

Color: Vertex and scutellum ivory white to light yellow with typical markings light brown. Pronotum gray, more or less flecked with fuscous. Tegmen semihyaline to white marked with fuscous, faint semblance of crossbanding usually evident, veins dark, apical cells partly infuscated.

Genitalia: Pygofer broad, bluntly pointed, about as wide at constriction as distance from there to apex; pygofer hook extending to margin of pygofer, bent into gooseneck near base, broadening to over twice narrowest width near middle, then narrowing to a sharp apex. Aedeagus in lateral view short, about two and one-half times basal width, narrowest on outer third, dorsal teeth small and pointed, in ventral view, broadening toward apex, bifurcate on outer third and bearing a pair of lateral processes almost one-third length of shaft of aedeagus. Styles about twice basal width, sinuately narrowed to outer fifth, apices slender and bluntly pointed.

Types: Holotypes male, allotype female and 3 male paratypes, Granite Dell, Ariz., May 30, 1935, P. W. Oman, in the National Museum, Washington, D. C. Additional paratypes as follows: 1 female, Huachuca Mts., Ariz., June 11, 1933, R. H. Beamer.

Aligia falcata n. sp.

Resembles *munda*, but with more rounded vertex, less cross-veins in tegmen and pygofer hook falcate. Length: male 5.25 mm., female 6.25 mm.

Vertex rounded, almost parallel margined, about four times as wide between eyes as length at middle, transverse furrow almost absent; few cross veins in tegmen, except in corium next clavus and in middle anteapical cell.

Color: Vertex and scutellum ivory white to yellow with markings indistinct except large brown spot in each basal angle of scutellum; pronotum grey to yellow, more or less irrorate with brown. Tegmen semihyaline to white with two indistinct fuscous bands separated by a light area about as wide as either, apex more or less infuscated.

Genitalia: Pygofer slender, about one and one-half times as long as width at constriction; pygofer hook falcate, almost parallel margined to outer fourth, then narrowed on dorsal margin to sharp apex. Aedeagus in lateral view slender, about twice as long as basal width, almost parallel margined to outer fourth, apex rounded; in ventral view parallel margined, bifurcate on outer fourth, and bearing a pair of lateral processes about as long as one-fourth length of shaft of aedeagus. Styles about twice basal width in length, sinuately narrowing to outer fifth, apices curved and pointed.

Types: Holotype male, allotype and 2 male paratypes, Oak Creek Canyon, Ariz., Aug. 14, 1927, R. H. Beamer, in the Francis

Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Additional paratypes as follows: 4 females, 1 male, Old Creek Canyon, Ariz., July 31, 1933, R. H. Beamer, 1 male, Aug. 9, 1932, R. H. Beamer; 1 male, Huachuca Mts., Ariz., Aug. 2, 1927, R. H. Beamer, 1 female, June 10, 1933, R. H. Beamer, 1 female, Oct. 30, 1937, P. W. Oman; 1 female, Grand Canyon, Ariz., July 28, 1936, J. D. Beamer, 1 female, Aug. 11, 1927, L. A. Anderson; 1 female, Prescott, Ariz., Aug. 7, 1932, J. D. Beamer, 1 female, July 29, 1933, R. H. Beamer.

Aligia curtipennis n. sp.

Resembling *jucunda* but slightly larger with a sharp vertex, shorter aedeagus and pygofer hook much wider on outer half than next base. Length: male 5 mm., female 5.75 mm.

Vertex slightly pointed, about three times as wide between eyes as length at middle, transverse furrow prominent. Tegmen marked about as in *jucunda* with cross-veins few in number.

Color: Vertex and scutellum ivory white to yellow with typical markings fuscous and distinct. Pronotum gray, more or less marked with fuscous, a narrow line along posterior margin and median longitudinal vitta unmarked, three pairs of dots along anterior margin usually distinct. Veins in tegmen fuscous with crossbands at least faintly indicated, apical cells partly infuscated.

Genitalia: Pygofer about as long as width at constriction, apex pointed; pygofer hook extended to margin of pygofer, parallel margined and bent into gooseneck on basal half, broadening to about three times narrowest width on apical third, then narrowing to short sharp point. Aedeagus in lateral view relatively short, narrowest near base, gradually widening to twice basal width on outer fourth and bearing a pair of lateral processes about one-fifth length of shaft of aedeagus. Styles about twice basal width, sinuately narrowed to outer fifth, apices strongly curved and blunt.

Types: Holotype male, allotype female and 5 female and 3 male paratypes, Cedar City, Utah, Aug. 13, 1929, R. H. Beamer, in the Francis Huntington Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Other paratypes as follows: 2 females, 3 males, Richfield, Utah, Aug. 19, 1930, E. W. Davis, 4 females, 2 males, Sept. 2, 1930, E. W. Davis, 4 females, 2 males, Sept. 12, 1930, E. W. Davis; 1 female, 5 males, Heber City, Utah, July 25, 1933, Davis and Dorst; 2 females, Salina, Utah, Aug. 15, 1930, E. W. Davis; 1 female, Elsinor, Utah, Oct. 5, 1929, David R. Fox; 1 female, Butlerville, Utah, Aug. 31, 1935, G. F. Knolton; 2 females, 3 males, Barclay, Utah, July 2, 1931, R. H. Beamer; 2 females, 7 males Pintura, Utah, Aug. 11, 1929, R. H. Beamer; 4 females, 15 males, Sloss, Colo., Aug. 17, 1929, R. H. Beamer; 2 females, 2 males, Palmer Lake, Colo., July 23, 1900, E. D. Ball, 3 females, 1 male, June 18, 1901, E. D. Ball; 2 females, 3 males, Glenwood Springs, Colo., Aug. 17, 1929, R. H. Beamer; 1 female, 5 males, Taos Pass, N. M., June 13, 1932, R. H. Beamer; 1 male, Oak Creek Canyon, Ariz., Aug. 9, 1932, R. H. Beamer, 1 male, July 31, 1933, R. H. Beamer; 2 males, Cloudcroft, N. M., June 28, 1932, R. H. Beamer; 1 male, Salida, Colo., July 24, 1900.

Aligia utahna n. sp.

Resembling *jucunda* but slightly larger with a sharp vertex, darker markings, less reticulations on tegmen and with the aedeagus somewhat longer. Length: male 5 mm., female 6 mm.

Vertex distinctly pointed, about two and one-fourth times as wide between eyes as length at middle, transverse furrow quite distinct. Venation of tegmen much as *jucunda*, usually with five to seven veins in the costa.

Color: Vertex and scutellum ivory white to light yellow with typical markings fuscous; pronotum gray, more or less mottled with fuscous, excepting a broad band along the posterior margin and longitudinal median vitta, three pairs of dark spots along anterior margin distinct; tegmen semihyaline to white with fuscous veins, crossbands sometimes very faintly indicated, apical cells mostly clear.

Genitalia: Pygofer oval, about three-fourths as broad at constriction as distance from there to apex; pygofer hook falcate, extending to margin, apex sharp. Aedeagus in lateral view long, clavate, narrowest on basal fourth, apex rounded, more than twice as wide as narrowest place; in ventral view bifurcate on outer fifth and bearing a pair of lateral processes about one-fifth length of shaft of aedeagus. Styles slender, almost three times as long as basal width, sinuately narrowing on outer fifth, apices almost parallel margined, apex curved dorsally.

Types: Holotype male, allotype female. Granite. Utah, June 26, 1936, M. W. Allen, in the National Museum, Washington, D. C. Paratypes as follows: 2 males, Butlerville. Utah, June 16, 1936. G. F. Knowlton; 1 female, 1 male, Panguitch, Utah, Sept. 4, 1932. E. W. Davis; 1 male, Salt Lake City, Utah, July 3, 1931, R. H. Beamer, 1 male, Sept. 5, 1933, Davis and Dorst; 2 males, St. George, Utah, May 1, 1933. E. W. Davis; 1 male, Barclay, Utah, July 2, 1931. R. H. Beamer; 3 males, Cove Fort, Utah, Aug. 14, 1929. R. H. Beamer; 2 males, Richfield, Utah, Fishlake Mt., Aug. 19, 1930; 1 male, Cedar City, Utah, Aug. 13, 1929, R. H. Beamer.



NOTE ON PTOMAPHAGUS CAVERNICOLA SZ*
IN ARKANSAS CAVES

This species was originally described from four specimens collected in Marble Cave, Stone County, Missouri, over 40 years ago, and has subsequently been recorded from Onyx Caves, Washington County, Missouri by Hatch. (Jr. N. Y. Ent. Soc., XLI, 1933, p. 204). Several caves in Washington and Benton Counties in Arkansas have yielded the species by hundreds. The beetles are found crawling over the cave floors, in bat and raccoon dung, in decayed vegetable debris washed and carried into the caves, and is attracted readily to ground beef and banana peel when allowed to decay. No specimens were collected within the "twilight" zone of the caves, but frequently many hundreds of feet from the entrances.

MILTON W. SANDERSON

*Coleoptera, Catopidae.

**BLISTER BEETLES AND LADYBIRD BEETLES TAKEN AT A
NEBRASKA LIGHT TRAP***

Don B. Whelan, University of Nebraska

For the six years, 1933 to 1938, inclusive, a light trap has been in operation in Lincoln in connection with a cutworm project. During these years a record of the various species and numbers of blister beetles and ladybird beetles was kept to learn their relative abundance, their seasonal activity and the reaction of the different species to lights. As a result of this study four species of blister beetles and nine species of ladybird beetles have been taken. The light trap was located on the corner of the insectary, about seven feet above the ground, and was visible for a long distance to the north, east and south.

Two different kinds of traps were used. In 1933 and 1934 a small rain-proof trap, designed by the writer was in operation and during the remainder of the time a larger open trap designed by H. H. Walkden was used. The former trap was equipped with a 200 c. p. mazda lamp and the latter with a 500 c. p. mazda lamp.

Blister Beetles (Meloidae)

1. *Macrobasis segmentata* Say. This species is represented by a single specimen caught on July 9, 1938.

2. *Macrobasis unicolor* Kby. The total number caught during the different years, with their peaks of abundance, was: 1933, 100 beetles, the first reported on June 2, the last on July 9 and the greatest number during the second week in June. In 1934, 21 beetles were taken, the first on May 8, the last on June 27 with the greatest number listed during the first week in June. In 1935, only one beetle was caught, on July 21. In 1936, 105 beetles were captured, the first on June 8, the last on July 13 with the greatest abundance during the second and third weeks of June. One-third of the adults were collected during the night of June 15. In 1937, 187 beetles were taken the first on May 28, the last on July 24, while the greatest number were caught during the third (70) and fourth (63) weeks of June. In 1938, 101 beetles were captured, the first on May 19, the last on July 5, with the greatest abundance during the fourth week and nearly half (49) on the night of June 23.

3. *Epicauta lemniscata* Fab. This was the most abundant species of blister beetle caught in the light trap during each of the years. Its activity also extended over a much longer period than any of the others. In 1933, 54 beetles were captured, the first on June 16, the last on September 2 with the seasonal activity general and no out-

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standing peaks of abundance. In 1934, 47 beetles were captured, the first on June 1, the last on September 12, with no peaks of abundance. In 1936, 75 beetles, the first on June 29, the last on September 13 with small peaks of abundance during the first weeks in August and September. In 1936, 1008 beetles were taken, the first on June 5 and the last on August 27. The greatest number were caught during the second and third weeks of July with the largest number between July 12 and 20 when 647 were captured. In 1937, 1491 beetles were taken, the first on June 3 and the last on September 18 with no real peaks of abundance. However, they were numerous during July and August. In 1938 occurred the greatest catch of any of the years when 3767 beetles were taken, the first ones on June 9 and the last on October 4. The largest number were taken during the third and fourth weeks in July. (The light was not in operation from July 30 to August 29.) The increase in abundance of this species during the past few years coincides with the continued abundance of grasshoppers.

4. *Pyrota engelmanni* (Lec.) Only four beetles were taken during the six years the light trap was in operation, as follows: 1936, one on May 30; 1937, one each on June 19 and 20, and, 1938, one on June 13.

Even though *Epicauta pennsylvanica* has been present on flowers and weeds nearby it has never been reported at any of the lights during the time of the above study.

Lady Beetles (Coccinellidae)

1. *Ceratomegilla fuscilabris* (Muls.). The only specimens of this species were taken in 1934 when one was caught in each of the two nights of June 6 and June 29.

2. *Hippodamia tredecim-punctata* (L.). In 1933, 63 beetles, the first on June 6, the last on September 13 with no peaks of abundance. The greatest single catch (11) was on July 15. In 1934, 43 beetles, the first on July 5, the last on August 9, with the greatest single catches (13 each) coming on the nights of July 5 and August 5. In 1936, 8 beetles, the first on June 4 and the last on July 7. In 1937, 78 beetles, the first on June 18, the last on September 14, with the largest number (13) on August 2. In 1938, 32 beetles, the first on July 2, the last on September 1 with the greatest number (8) caught on July 27.

3. *Hippodamia parenthesis* (Say). Only two specimens were taken both on July 5, 1935.

4. *Hippodamia convergens* Guer. In 1933, 9 beetles, the first on August 12 and the last on September 12. In 1934, 61 beetles, the first on May 8, the last on June 20 with the greatest number (46) caught between May 30 and June 2. In 1935, 8 beetles, the first on July 2 and the last on September 20 with four taken on July 5. In

1936, one beetle taken on August 12. In 1937, 43 beetles, the first on May 28, the last on August 11, with the greatest number (12) on August 3. In 1938, 20 beetles, the first on June 5, the last on September 27 with no peaks of abundance.

5. *Cycloneda sanguinea* (L.). In 1933, 7 beetles, the first on June 6, the last on September 22, with one each during July and August. In 1934, 13 beetles, the first on June 2 and the last on July 9, the largest number (5) caught on June 6. In 1935, 9 beetles, the first on June 26 and the last on August 25 with no more than a single specimen caught during any one night. In 1936, 5 beetles, the first on June 18 and the last on July 12. In 1937, 5 beetles, the first on June 18 and the last on August 3. In 1938, 4 beetles, the first on June 13, two during July and the last on September 23.

6. *Olla abdominalis* (Say). In 1933, 148 beetles, the first taken on June 7, the last on September 25 and most numerous from September 9 to 22. In 1934, one beetle caught on May 21. In 1935, two beetles, one each on August 5 and 10. In 1936, 10 beetles, the first on May 15, the last on August 14 and the remainder during the first half of July. In 1937, 10 beetles, the first on June 18, the last on September 14 with two in July and one in August. In 1938, 41 beetles, the first on June 13, the last on October 17 and most numerous during early October.

7. *Adalia bipunctata* (L.). In 1933, 23 beetles, the first May 20, the last on August 15 but most numerous during the second and third weeks in July. In 1934, 2 beetles, both taken on May 2. In 1935, 15 beetles, the first on June 24, the last on October 12 with no periods of abundance. In 1936, no beetles captured. In 1937, 4 beetles, all between June 20 and 23. In 1938, no beetles taken.

8. *Neomysia horni* var. *interrupta* Csy. Only one specimen taken, on Aug 9, 1937.

9. *Chilocorus bivulnerus* Muls. In 1933, 18 beetles, the first taken on June 6, the last on September 9 with no peaks of abundance. In 1934 and 1935, no beetles captured. In 1936, 1 beetle taken on July 6. In 1937, 3 beetles, taken on June 19, June 20 and July 28. In 1938, 6 beetles, the first on June 30 and the last on September 7.

A NEW CAVE BEETLE OF THE SUBGENUS ADELOPS
FROM OKLAHOMA*

Milton W. Sanderson, University of Arkansas

Ptomaphagus (Adelops) shapardi n. sp.

Length: 2.1-2.4 mm.; width: 1-1.2 mm.

Male:—Elongate oval, convex, rather strongly narrowed behind; color yellowish brown. Head very finely and evenly punctate, the hairs very short and erect. Eye very small, somewhat triangular and slightly more than its own width from base of antenna, usually strongly pigmented, often with an entire light margin around the area of pigmentation. Antenna testaceous and extending to posterior thoracic angle. Segments one to seven elongate, first segment wider and slightly longer than second and third segments which are subequal, fourth very slightly longer than fifth which is equal to and as broad as sixth, seventh longer than sixth widening toward apex, eighth narrower than seventh about one half wider than long and one half the length of ninth, ninth and tenth about as wide as long, wider toward apex, eleventh longer than tenth and narrowed in apical one half. The last five segments of antenna with a few long bristling hairs. Pronotum subequal in width to elytra, widest in basal one-fourth, two-thirds as long as wide. Hind angles acute, rather strongly sinuate on the inside. Surface very strongly transversely and irregularly strigose, especially near the posterior angles. Sides of prothorax gradually rounded from base to apex, the apex about two-thirds the width of base. Surface clothed with short decumbent hairs. Elytra widest at basal one-fifth thence rather suddenly narrowed to apex. Length a little more than twice that of pronotum. Surface obliquely strigose. Apex of each elytron nearly sub-truncate, broadly angulate internally and separately rounded. Entire upper surface clothed with short decumbent hairs among which there are five rows of short and erect hairs extending from base to apex. Basal four segments of front tarsi broadened and pubescent beneath.

Female similar to male except as follows: fourth antennal segment narrower than sixth, fifth slightly shorter than sixth, eighth fully twice wider than its length. Elytral apex obliquely sub-truncate and narrowly rounded at sutural angle.

Holotype male, allotype female, 21 paratypes, Dresser Cave, five miles north of Ft. Gibson, Oklahoma, January 13, 1939, E. R. Shapard. Three additional paratypes, same locality December 27, 1938, E. R. Shapard. All specimens collected in gravelly debris, in total darkness, about fifty feet from entrance of cave. Types and paratypes in the collection of the author. Additional paratypes in

*Coleoptera: Catopidae.

the U. S. National Museum, American Museum of Natural History, and the University of Kansas.

This species is the sixth of the subgenus *Adelops* to have been described from our fauna. The species is perhaps more closely related to *mittellensis* Hatch by virtue of the pigmented condition of its eyes, the shorter antennae, and the acute hind angles of the pronotum. It differs, however, in its comparatively smaller size, the presence of distinct transverse strigae on the pronotum, and the longer third segment of the antenna. In *mittellensis*, the third segment was described as shorter than the second while in this species it is fully as long. From other species in the genus the female differs readily by its non-spinose elytral apices.



A NOTE ON FULGORIDS

In making a revision of the taxonomy of the sub-family Issinae, Fulgoridae, in America north of Mexico, two parts of which have already been published and two other parts of which are in manuscript, a few interesting facts of distribution have come to light. One noticeable fact is that the sub-family is primarily a southwestern group. Many of the species are taken only in California or Arizona, or both. For others, additional records are found, including a few other western states and western Canada, but the majority of species occur west of Kansas. Of the twenty-two genera occurring in the territory covered by the monograph, only three have been taken in Kansas, and of the 131 species discussed, only eleven are recorded from Kansas. The species known to occur in Kansas are:

Bruchomorpha oculata Newman—a new record

Bruchomorpha tristis Stal—a new record

Bruchomorpha jocosa Stal

Bruchomorpha dorsata Fitch

Bruchomorpha pallidipes Stal

Bruchomorpha n. sp. (in manuscript)

Fitchiella fitchi (Melichar)

Fitchiella robertsoni Fitch

Aphelonema rugosa (Ball)

Aphelonema bivittata (Ball)

Aphelonema simplex Uhl.

KATHLEEN DOERING

TWO NEW CORIXIDAE FROM MEXICO

H. B. Hungerford, Lawrence, Kansas*

In 1933 Dr. T. Jaczewski¹ described *Sigara ocotlanensis* from a male specimen lacking both front and middle legs. His specimen came from Ocotlan, Mexico. Since the front pala of this insect is lacking, it is necessary to base the determination of this species upon such other characters as are mentioned in his description and upon his sketches of right clasper, strigil, and seventh abdominal tergite. Since he states that the "species seems to stand closest of all to *Arctocorixa beameri* Hungerford," to possess a prestrigilar tuft of hairs on the fifth abdominal tergite, and to have the central lobe of the seventh abdominal tergite strongly developed, I have been hoping to recognize the species amongst the numerous collections of Mexican Corixidae available to me. However, the species which I tentatively identified as *S. ocotlanensis* appears upon closer analysis not to be that species and I describe it below:

Sigara beamerioidea new sp.

Size: Length 5.7 mm. to 6 mm.; width across head 2 mm. to 2.1 mm. A fairly short compact species.

Color: General facies as in *S. beameri* (Hungerford), the pale lineations not conspicuous. About eight pale bands on pronotum, those on hemelytra more or less effaced, the lighter figures broad, yet so dark that the general effect is dark.

Structural Characteristics: Head broad and short, that of male slightly longer than that of female as seen from above. Interocular space slightly greater than eye width in female. Face of male broadly depressed. Pronotum, clavus and basal half of corium rastrate. Legs short and stout. Metaxyphus long and slender. Odoriferous gland pores guarded by some strong spinelike hairs. The pala, abdominal dorsum and the genital capsule of the male as shown in the drawings.

Location of Types: Described from seven males and seven females taken twelve miles west of Villa Victoria, State of Mexico, March 23, 1939. I also have three males from Puebla Puebla, Mexico, taken by Henry Thomas, August 16, 1937. Holotype, allotype, and paratypes in Francis Huntington Snow Entomological Museum.

Comparative Notes: This species must be very near *S. ocotlanensis* Jaczewski, from which it differs in characters that cannot be ignored. The shape of the seventh abdominal tergite cannot be reconciled with the drawing given by Dr. Jaczewski of his species. The strigil, while guarded by hairs projecting from a lobe of the

*Contribution from the Department of Entomology, University of Kansas.

¹Annales Musei Zoologici Polonici, Tom IX, Nr. 21, pp. 333-335.

fifth tergite, consists of six or eight rows instead of four as in *S. ocotlanensis* Jaczewski, and the right clasper has a characteristic bend on its concave margin not seen in Dr. Jaczewski's species. It also lacks the small denticulations on its inner margin just before the blunt apex described from Dr. Jaczewski's species. In none of the seventeen specimens is there any clear indication of a pale, oblique stripe on the membranal suture. In all of my specimens the left membrane is hyaline, the right one more pigmented.

Sigara conata n. sp

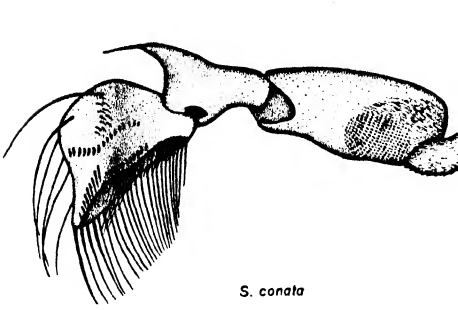
Size: Length 5.7 mm.; width across the head 2.1 mm. A fairly short, compact species.

Color: General facies much as in *S. beameri* Hungerford, the pale lineations not conspicuous. Eight or nine pale bands on pronotum, those of hemelytra more or less effaced, the lighter figures broad, yet so dark that the general effect is dark.

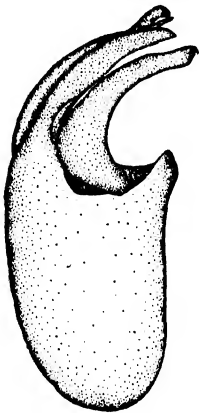
Structural Characteristics: Head broad and short, shorter than in the species above. Face of male only moderately flattened, not depressed. Front margin of vertex broadly rounded as seen from above. Pronotum, clavus, and base of corium rastrate. Legs relatively longer than in above species, the middle femur having a thick patch of straw colored hairs on the distal third of the rear margin. These are matted down in the two specimens at hand and give the femur the appearance of being enlarged on its outer third. Metaxyphus long and slender. Odoriferous gland pores, prominent and guarded by hairs. The pala, abdominal dorsum and the genital capsule of the male as shown in the drawings.

Location of Types: Described from two males taken twelve miles west of Villa Victoria, State of Mexico, on March 23, 1939. Types in the Francis Huntington Snow Entomological Collections.

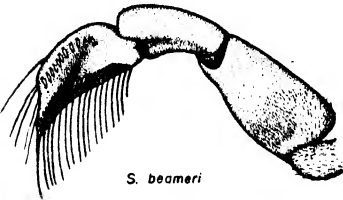
Comparative Notes: This easily identified species is somewhat uncertain in its relationships. The strigil is located at the end of an elongation of the sixth abdominal tergite. *Sigara* (*Morphocorixa*) *lundbladi* Jacz. and *Sigara* (*Morphocorixa*) *compacta* (Hungerford) have a similar prolongation but no strigil. The pala is unique, while the cone-shaped expansion of the front tibia may be an extreme expression of a much less noticable expansion of the tibia in *S. beameri* (Hungerford). The right lobe of the eighth abdominal segment is but slightly constricted at its outer base and does not show any indication of the lateral projection of this lobe which is so characteristic in *Sigara* (*Morphocorixa*) *lundbladi* Jaczewski.



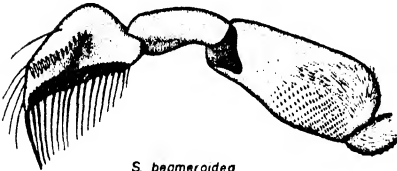
S. conata



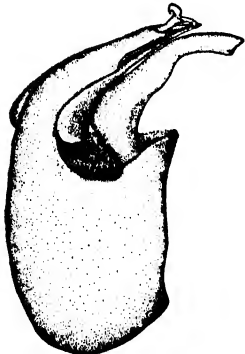
S. conata



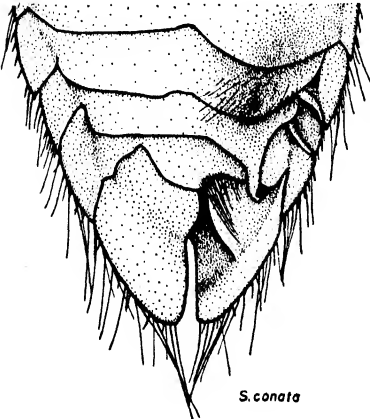
S. beameri



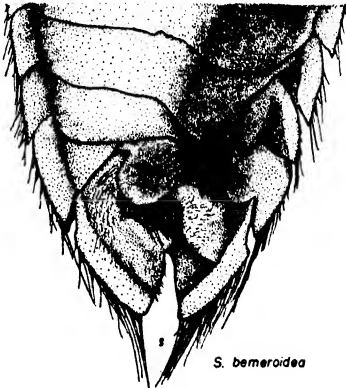
S. beamerioidea



S. beamerioidea



S. conata



S. beamerioidea

THE LIFE HISTORY OF BITTACUS STRIGOSUS WITH A DESCRIPTION OF THE LARVA.

L. R. Setty, Park College, Parkville, Missouri

(Family Bittacidae, Order Mecoptera)

The adults of *Bittacus strigosus* (striated hanging-fly) are found in shady woodlands during the summer months. They often occur in great numbers among the low herbs from which they hang by their front pair of tarsi and wait for prey.

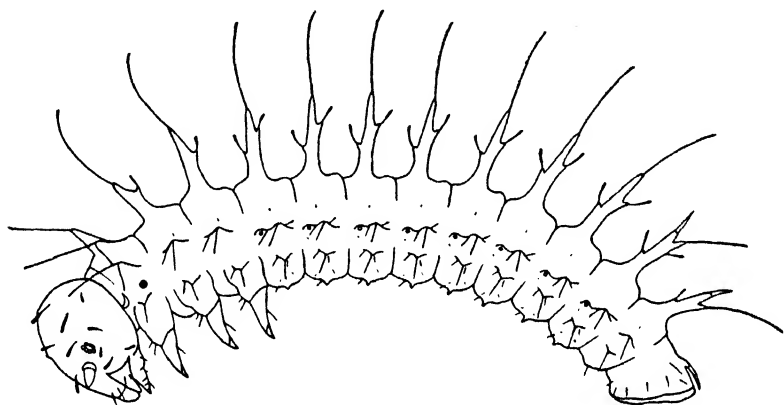
From a wooded area at Ithaca, New York, the writer collected during July, 1938 some of the females and placed them in individual cages (half-pint fruit jars), each with a small twig for support of the hanging-fly. Within a few hours, eggs were deposited upon the bottom of the cage. These eggs were collected and placed between two thin layers of asbestos. The latter were arranged upon the ground in a small screen framework for the winter.

The eggs hatched on May 5. The larvae were then placed upon some damp soil in a glass container and were provided with bits of earthworm for food. Growth was completed by May 25, at which time the larvae entered the soil to pupate. The adults emerged from the soil on June 12. Thus the whole life cycle of *B. strigosus* requires one year, the winter being passed in the egg stage.

The description of the larva of *B. strigosus* (together with a figure of a lateral view of the first instar) is given here as follows:

Length of one day old larvae 3 mm.; width .64 mm.; width of head capsule .56 mm. Length of mature larvae 14 mm.; width 4 mm.; width of head capsule 1.5 mm. Body eruciform type and arched upward. Segmentation distinct. Head hypognathous. General body color gray; head brown. Anterior margin of pronotum with three dorso-cephalic seta-bearing protuberances on each side; the most lateral protuberance with a very small seta-bearing protuberance attached to its base in the full grown larva. Most of the body segments with a pair of elongate dorsal protuberances; each protuberance with a long filiform seta at its distal end and with two small seta-bearing protuberances on its surface. These protuberances on thorax frequently with soil packs and surface of body with thin film of soil. The dorsal protuberances about as long as the height of the body segment in very young larvae; but distinctly shorter than height of the body segment in older larvae. Dorsal protuberances of the eighth and ninth segments terminating in a peg-like seta and with three small seta-bearing protuberances on their surface. Tenth segment with but a single median protuberance bearing a peg-shaped seta. Each side of nearly all body segments with a lateral protuberance bearing three setae; ventrad of each lateral protuberance, a small one with three setae. A spiracle present on

each of the first eight abdominal segments cephalad of main lateral protuberance; one larger spiracle near the caudal margin of each side of the prothorax. Prothoracic legs closer together than those of meso- and meta-thorax. One pair of prolegs on the first eight abdominal segments. Last abdominal segment with protrusile sucker around the anus. Antennae short. Group of seven ocelli caudo-dorsad of each antenna; one large ocellus at the anterior end of the coronal suture. Mandibles dark brown at distal end. Setae of head slightly clavate.



The egg and the pupa of *B. strigosus* are much like those of Say's hanging-fly (1931 Setty: Biology of *B. stigmaterus*, Ann. Ent. Soc. Amer. 24: 467-484) and those of the brown-spotted hanging-fly (*B. punctiger* in the author's thesis at Cornell University). The adult of *B. strigosus* is, of course, well known to most entomologists.



A FAMILY OF COLEOPTERA, BRATHINIDAE, NEW TO ARKANSAS

On October 31, 1938, in Benton County, Arkansas, the writer collected five specimens of *Brathinus nitidus* LeC. The beetles were taken in damp to wet leaves, in a deep and narrow ravine, near the mouth of a sink hole. The individuals were very active and in nature strongly resembled some of the more slender Carabidae or Scydmaenidae. The superficial resemblance to the latter family is so strong that LeConte was originally led to include the two eastern species in the Scydmaenidae. The only other species known in the United States are *Brathinus varicornis* LeC., described from New York, and *Brathinus californicus* Hub. *B. nitidus* LeC. has heretofore ranged from New York to Nova Scotia westward to the Lake Superior region. Little is known regarding the habits of this family.

MILTON W. SANDERSON

THE BIOLOGY OF *LEMA SEXPUNCTATA* OLIV.¹Garvin Green, Department of Entomology, University of Arkansas²

*Lema sexpunctata*³ is a leaf beetle in the subfamily Criocerinae which feeds on the day flower, *Commelina communis* L., in both larval and the adult stages. The species is of interest because the larva forms a frothy cocoon in which it pupates, a habit not common among leaf beetles. The larvae, like those of other species in the genus, carry excrement on their back. The adults stridulate when picked up although they have not been heard making sounds when undisturbed. All stages occur above the ground.

SYSTEMATIC POSITION

Lema sexpunctata was described by Oliver in 1808 (2). There is only one synonym, *L. sexmaculata*, a name assigned to the species by Germar in 1823 (2). *L. albina* Lac and *L. ephippium* Lac. are listed by Leng as varieties.

Habits

Lema sexpunctata apparently has but a single host plant, the day flower, *Commelina communis*. The adult feeds on the foliage, eating holes in the leaves or destroying the entire tissue. If the beetles are present in large enough numbers stripping foliage often occurs, and if the day flower were a plant of economic importance this *Lema* would be rated as a pest.

The beetle is diurnal. When the adult is disturbed it drops to the ground where it runs away or takes short flights to other plants. When picked up the beetle stridulates by rubbing the pygidium against the apices of the elytra.

Eggs are deposited on their sides, on the underside of the leaf. The eggs may be deposited singly but are usually in small groups.

The larva feeds on the epidermis of either side of the leaf or on the stem, without eating holes through the leaves as do the adults. Excrement is carried on the back of the larva during the feeding period. The anus is located dorsally just before the apex. When the larva has passed 4 instars and is full grown, it drops to the ground to spin its cocoon.

The full grown larva prefers a dark place as under leaves or trash to spin its cocoon. A white foamy substance issues from the mouth to form the cocoon around the larva. The secretion dries and becomes quite strong. The larva ceases active cocoon spinning when

¹Research Paper No. 654. Journal Series, University of Arkansas.

²The writer wishes to acknowledge help received from various members of the Department of Entomology at the University of Arkansas—Professor Dwight Isely for suggesting the problem and general procedure; Doctor Albert Miller for checking the drawings; Doctors W. J. Baerg and H. H. Schwardt for photographs.

³Family Chrysomelidae, order Coleoptera.

being observed, probably because of disturbing light. The foamy substance is arranged by the mouth around the body of the larva.

The egg is cylindrical with the ends rounded, and is about .88 mm in length and .42 mm in diameter. Its color is translucent white and the surface is smooth and shiny.

There are four larval instars. The larva is white with a translucent tan stripe down the back. The head is black in the first instar and white to tan in the remaining instars. When viewed from above the larva is ovoid in outline tapering considerably anteriorly. Its greatest width is about at the fifth abdominal segment.

A larva has six ocelli on each side of the head.

The width of the head capsule of the larva of each instar is as follows:

First instar.....	.33 to .34 mm.
Second instar.....	.49 to .51 mm.
Third instar.....	.66 to .68 mm.
Fourth instar.....	.84 to .85 mm.

The pupa is clear white in color and varies in length from 4.5 mm. to 5.5 mm. The elytra and wings overlap the fifth abdominal segment; the femora and tibiae are exposed and the hind tarsi reach the seventh abdominal segment. The caudal segment bears a pair of spines, the cremaster. No other spines are present.

Rearing Methods

Life history studies of *Lema sexpunctata* were carried on in a screen sided insectary where temperatures were as nearly normal as possible. The period of rearing of the immature stages extended from June 14 to July 26, 1938. Temperature was recorded by a thermograph and the mean for each day was determined by taking an average for each two-hour period. The average of daily means was determined to get the mean for duration of immature stages.

Half-pint jelly glasses were used as cages for rearing the immature stages. Moistened earth was placed in the glasses to a depth of about one-half inch. Leaves of the day flower were used as food for the larvae. Battery jars capped with muslin were used for preoviposition records of the adults. Some adults were also reared inside screen cages which were placed over plants growing in three-gallon stone jars. The habits of oviposition and spinning cocoons, were observed in these cages.

DURATION OF STAGES

The incubation period of 375 eggs of *Lema sexpunctata*, recorded at temperatures ranging from 23° to 29° C., varied from 2 to 6 days, the longer period occurring at lower temperatures. The average duration of incubation period throughout the entire series was 4.11 days. The eggs were deposited over a period of 35 days from June 17 to July 22.

Table 1. *Lema sexpunctata*. Duration of Incubation Period. 1938.

Temperature		Duration of Egg Stage		Number of Eggs
°C	°F	(Days)	Average	
23	73.4	4.88 ± .04		132
24	75.2	4.00 ± .00		54
25	77.0	3.95 ± .09		21
26	78.8	3.77 ± .07		48
27	80.6	3.52 ± .07		79
28	82.4	3.09 ± .10		32
Total				366

The feeding period of 199 larvae which were reared at daily mean temperatures ranging from 20° to 29° C. varied from 5 to 13 days. The average for the entire series of larvae reared was 7.80 days. These rearing records were secured between June 16 and July 23

Table 2. *Lema sexpunctata*. Duration of Larval Feeding Period. 1938

Temperature		Duration of Larval Feeding Period (Days)		Number of larvae
°C	°F			
23	73.4	9.41 ± .17		53
24	75.2	7.60 ± .25		41
25	77.0	7.40 ± .22		22
26	78.8	7.02 ± .16		48
27	80.6	6.59 ± .26		27
28	82.4	6.00 ± .00		4
Total				195

The entire period in the cocoon of 137 individuals reared at temperatures ranging from 20° to 29° C. varied from 8 to 13 days. The average of the period in the cocoon for the entire series was 10.56 days. In a small number of cocoons which were broken open for observation the prepupal period was 3 days.

Table 3. *Lema sexpunctata*. Duration of the Period in Cocoon. 1938

Temperature		Duration of Period in Cocoon (Days)		Number of Cocoons
°C	°F			
23	73.4	12.62 ± .14		24
24	75.2	11.65 ± .22		26
25	77.0	10.40 ± .13		25
26	78.8	9.60 ± .09		55
27	80.6	10.14 ± .26		7
Total				137

The preoviposition period of females in 9 different cages varied from 1 to 12 days. Two females required over 7 days for the preoviposition period and the average was 5.67.

At temperatures of about 28° C. it would be possible for *Lema sexpunctata* to develop from the egg stage to an emerged adult in 17 days, allowing 3 days for incubation, 6 days for the larval feeding period and 8 days in the cocoon. In addition to this about 5 days would be required from emergence to sexual maturity of the adult. The total time required for the completion of the life cycle under optimal conditions therefore would be 22 days.

SEASONAL HISTORY

Lema sexpunctata hibernates as an adult. All stages can be found from May to September. The number of generations per year was not determined.

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2. Leng, Charles W. 1920. Catalogue of the Coleoptera of America north of Mexico, p. 287.

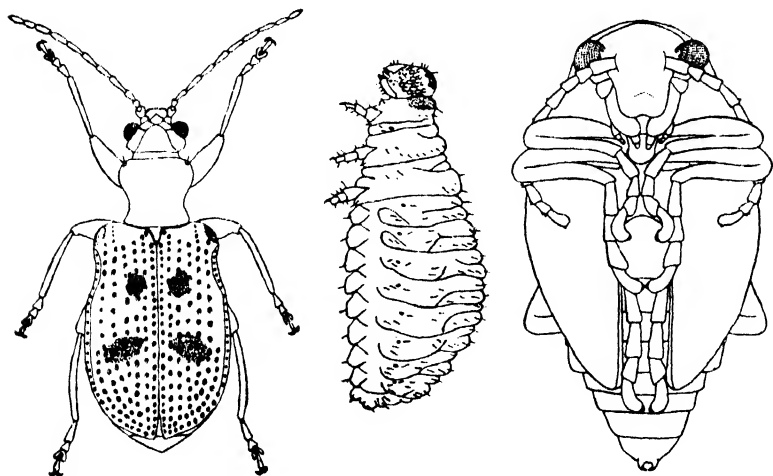


Plate 1. *Lema sexpunctata*, left to right, adult, larva, and pupa.

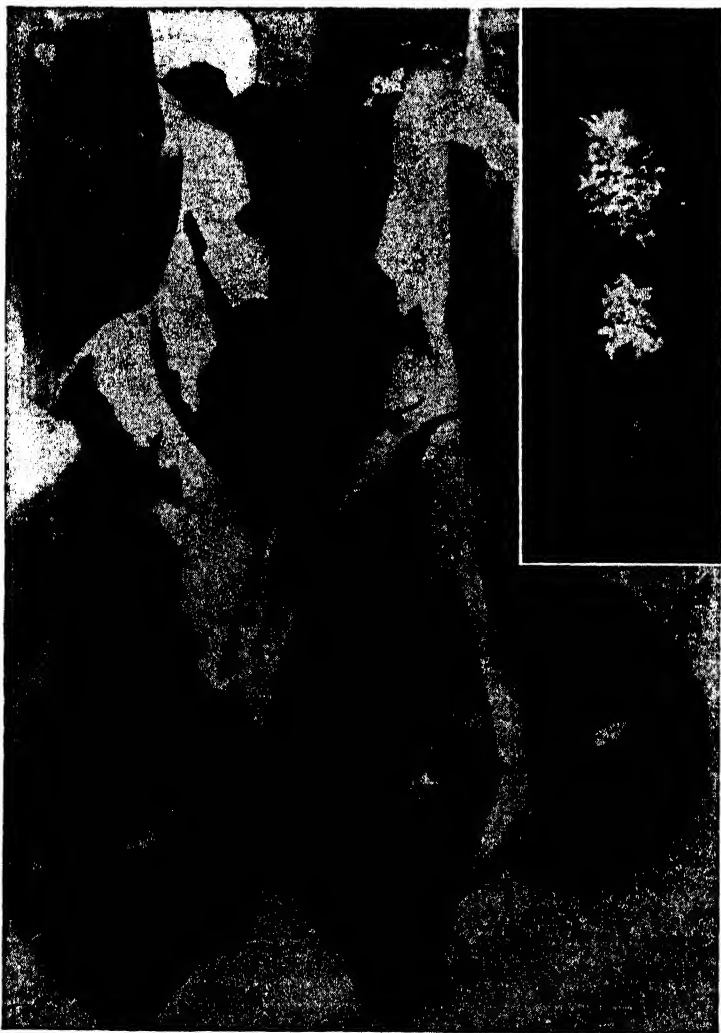


Plate 2. Stages of *Lema sexpunctata* Oliv. showing eggs, larvae, and cocoons, on foliage.

A NEW CORIXID FROM MEXICO

H. B. Hungerford, Lawrence, Kansas*

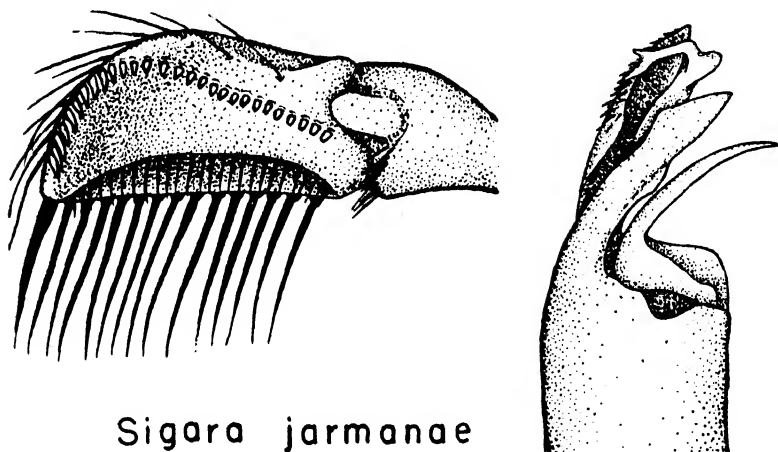
For many years I have had a couple of specimens of an undescribed Corixid from Santiago de las Vegas, Cuba. During the summers 1937 and 1938 Mr. Henry Thomas has collected good series of this same species in Chiapas, Mexico, and I therefore describe it.

Sigara jarmanae

Size: Length, 5.6 mm. to 6 mm.; width of head across the eyes, 1.8 mm. to 1.95 mm.

Color: General facies moderately light. Head, legs and venter pale, except venter of male abdomen which is more or less embrowned, the two basal segments having dark areas laterally. The pronotum crossed by seven to nine brown stripes which are narrower than the pale interspaces and margined by brown line; the brown markings of hemelytra in reticulations, not in transverse stripes except on base of clavus when they are erased on inner angle; pale indistinct line between corium and membrane; the hemelytra sometimes semi-hyaline with pattern indistinct.

Structural Characteristics: Head in both sexes rounded in front as viewed from above, interocular space at synthlipsis nearly as wide as an eye in the male. Frontal depression of male ovate, margin not prominent, not attaining eyes laterally. Postocular space narrow, broadest at inner angle of eye; antennal segments 1:2:3:4::9:7:17:9. Slight longitudinal median carina on anterior third of pronotum. Surface of pronotum moderately and clavus faintly



*Contributed from the Department of Entomology, University of Kansas.

rastrate. Lateral lobe of pronotum tongue-like in shape, about twice as long as wide. Metaxyphus long. Basal half of hind femur pilose beneath. Pala of male as shown in figure, 28 to 31 pegs in row. No strigular patch of pegs on base of femur. Measurements of front leg of male as follows: Femur: tibia: pala :: 15:7:11 (the pala and tibia measured on upper margin). The middle leg: Femur: tibia: tarsus: claws:: 45:22:14:21. The hind leg: Femur: tibia: 1st tarsal: 2nd tarsal:: 25:24:30:11. The male pala and genital capsule as shown in the drawings. The spinose left clasper and the unique modification of the end of the penial sheath are characteristic.

Described from 34 specimens labeled "Comitan, Chiapas, Mexico, Aug. 30, 1937, H. D. Thomas." A second lot taken Aug. 27, 1938, from same place and comprising 96 specimens. Specimens also come from Lake Tepancuapan, Chiapas, Mexico, Aug. 28, 1937; Ocozocoantla, Chiapas, Mexico, Sept. 3, 1937.

This same species has been taken in Cuba.

Location of Types: Holotype, allotype, and many paratypes in Francis Huntington Snow Collection, University of Kansas.



A NEW SPECIES OF *PLEBEJUS* KLUK FROM IDAHO

(Lepidoptera: Lycaenidae)

William D. Field, Lawrence, Kansas*

Plebejus atrapraetextus Field, n. sp.

Male: Palpus white covered with black scales along inner edge of terminal subsegment and with fringe of long, intermingled, black and white scales along outer edge of first and second segments. Antenna black annulated with white at the base of each subsegment. Antennal club black with a large group of white scales just below the tip on the upperside and dull dark brown below. Head white except for black color and a V-shaped area on frons, composed of tufts of long black scales. Thorax black, sparsely covered with long bluish white scales above and densely covered with white scales and long white hairs beneath. Legs white in color and hairy with black along upper side at base of each tarsal subsegment. Abdomen white beneath and black or dark brown above.

Wings above hyssop violet¹ with broad fuscous borders two millimeters in width along outer margin of fore wing and along fore and outer margin of hind wing. Veins fuscous, particularly in outer two-thirds of the wings. In the hind wings of some specimens the hyssop violet ground color encroaches upon the dark border along the veins giving the border a scalloped appearance. The fringe of scales along the outer margin of the fore and hind wing is white except for the basal third of its width which is fuscous. This fringe of scales is replaced by a fringe of white hairs along the inner margin of fore wing and by dirty brownish white hairs along the abdominal margin of hind wing.

Wings below, light pearl grey, almost white with a brownish cast, at least in the basal area. Fore wing with a black bar across the apical end of discal cell and a submesial series of six, nearly round, subequal, black dots. A similar submesial row in hind wing contains seven dots. In both fore and hind wing this row is nearly parallel to the outer margin but is tortuose, particularly in the hind wing. Hind wing with a series of three round black spots across the base and a dark bar at the outer end of the discal cell. All black markings described above are outlined by pure white. Fore and hind wing with a narrow black marginal line that is thickened at the ends of the veins, particularly in hind wing. Fringe of scales along the outer edge of both fore and hind wing pure white in color. In the marginal white fringe of hind wing, adjacent to ends of veins there are a few black scales. These scales with the adjacent thickened portions of the black marginal line have the appearance of a series of black spots connected with a fine black line. In both fore

*Contributed from the Department of Entomology, University of Kansas.

¹Color nomenclature used in this paper is from Ridgway, 1912.

and hind wing there is a submarginal row of round dark brown or black spots which in the hind wings, particularly in the lower half, are covered by metallic green scales. These submarginal spots in both fore and hind wing are surmounted by ochraceous buff or ochraceous orange lunules that become crescentic in shape in the lower half of the hind wing, with arms that extend outward along the veins to the marginal black line. These ochraceous spots are capped on their inner sides by narrow, bent, dark brown or black crescents. Between the series of submesial black spots (already described) and the submarginal markings, particularly in the hind wing, the ground color is nearly pure white.

Female: Palpus, antenna, head and thorax quite similar to those of the male. Abdomen dirty brownish white underneath and dark brown above.

Wings above Prout's brown, cinnamon brown or a shade between the two in color. A submarginal series of ochraceous buff or ochraceous orange crescents partially enclosing small dark brown spots on their outer sides and running along the outer margin is found in both fore and hind wing. Underneath the female is quite similar to the male except for a much warmer brownish cast to the ground color and except for a more distinct submarginal row of ochraceous buff or ochraceous orange lunules on the fore wing.

Comparative notes: This species belongs to the *anna-melissa* group of the genus *Plebejus*. It is quite distinct from all other North American members of the group, particularly in the possession of the rather wide fuscous border on the upper surfaces of the wings in the male sex. In the other members of this group there may be a fuscous or black marginal line, never more than one-fourth or one-half of a millimeter in width, along the outer margins of these wings. The maculation of the under surfaces shows its affinity to *anna*, but in *atrpraetextus* the maculation is more distinct as is evidenced in the larger and darker markings in the submarginal row and in the wider and darker marginal black line. *Atrpraetextus* is also closely related to *melissa* but the ochraceous submarginal markings are broad, forming a distinct and continuous band in this last species.

Data: Holotype, male, Priest River, Idaho, July 20; allotype, female, same data; paratypes, male, numbers 1 through 3, same data; paratype, male, number 4, same locality, July 11, 1927; paratypes, male, numbers 5 through 12, same locality, July 15, 1932; paratypes, male, numbers 13 and 14, Laclede, Idaho, July 6. All types collected by Mr. C. W. Herr of Woodburn, Oregon. Holotype, allotype and paratypes number 1, 2 and 18 in the author's collection. Paratypes number 5 through 12 in the collection of the Cheyenne Mountain Museum, Colorado Springs, Colorado. Paratype number 14 in the collection of C. W. Herr. Paratype number 3 to be deposited in the Francis Huntington Snow Entomological Collections, University of Kansas, Lawrence, Kansas. Paratype number 4 to be deposited in the Los Angeles Museum, Los Angeles, California.

INDEX--VOLUME 12

Journal of the Kansas Entomological Society

	Page
<i>Aedes thibaulti</i> Dyar and Knab, Habits of	70
<i>Aligia</i> , New Species of	105
<i>Batazonus navus</i> Cresson, Some Notes on the Nesting Habits of ..	87
Beamer, R. H., Articles by	26, 81
<i>Bittacus strigosus</i> , The Life History of . . . with a Description of the Larva	126
Blister Beetles at Nebraska Light Trap	118
Brathinidae, New to Arkansas	127
Bruce, W. G., Article by	91
Bryson, Harry R., Article by	94
Bugbee, Robert E., Article by	87
Calana, The Genus	81
Cave Beetle of the Subgenus <i>Adelops</i> from Oklahoma, A New...	121
Corixid from Mexico, A New	133
Corixidae from Bolivia, Two New	97
Corixidae from Mexico, Two New	123
Doering, Kathleen, Note by	122
Dolichopodidae, Three New	83
Field, William D., Article by	135
Fulgorids, A Note on	122
German Roach, Some Factors Influencing the Number of Molts of	73
Green, Garvin, Article by	128
Hardy, D. Elmo, Article by	16
Harmston, F. C., Article by	83
Hepner, Leon, Article by	105
Horsfall, William R., Article by	70
Hungerford, H. B., Articles by	97, 123, 133
Hungerford, H. B., Notes by	31, 72
Insect Edaphology, Some Observations on	91
Isely, Ewight, Article by	30
James, Maurice T., Articles by	32, 37
Knowlton, G. F., Article by	83
Ladybird Beetles at Nebraska Light Trap	118
Leafhoppers, Four New Species of . . . and Notes on Two Others	26
<i>Lema sexpunctata</i> Oliv., The Biology of	128
Minutes of the 15th Annual Meeting	100
Phyllophaga from Texas, New and Little Known	47
<i>Phyllophaga lanceolata</i> Say, Some Recent Observations on the Activities of	94
Pipunculidae (Diptera), New Nearctic	16
<i>Plebejus Kluk</i> from Idaho, A New Species	135
<i>Ptomaphagus cavernicola</i>	117
Reinhard, H. J., Article by	47
Ritcher, P. O., Article by	64
Sanderson, Milton W., Articles by	1, 121
Sanderson, Milton W., Notes by	117, 127
Scarabaeidae, A New Genus . . . with Description and Notes on <i>Phyllophaga</i>	1

Seamans, Lois, Article by -----	73
Setty, L. R., Article by -----	126
<i>Sigara griffini</i> (Kirk.) . . . A Note on -----	72
Stratiomyidae, Studies in Neotropical -----	32, 37
<i>Thyanta custator</i> (Fabr.), Mass Flights of the Pentatomid in Kansas -----	77
Über Entomologische Sammlungen---Walther Horn -----	31
Vegetable Weevil in Arkansas, Distribution of the -----	30
Whelan, Don B., Article by -----	118
White Grub Pupation, Observation on -----	64
Wilbur, Donald A., Article by -----	77
Woodruff, Laurence C., Article by -----	73

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CONTENTS OF THIS NUMBER

New Species of <i>Aligia</i> (Homoptera Cicadellidae), Leon Hepner	105
Note on <i>Ptomaphagus Cavernicola</i> Sz in Arkansas Caves, (Note) Milton W. Sanderson	117
Blister Beetles and Ladybird Beetles taken at a Nebraska Light Trap, Don B. Whelan	118
A New Cave Beetle of the Subgenus <i>Adelops</i> from Oklahoma, Milton W. Sanderson	121
A Note on Fulgorids, (Note) Kathleen Doering	122
Two New Corixidae from Mexico, H. B. Hungerford	123
The Life History of <i>Bittacus Strigosus</i> with a Description of the Larva, L. R. Setty	126
A Family of Coleoptera, Brathinidae, New to Arkansas, (Note), Milton W. Sanderson	127
The Biology of <i>Lema Sexpunctata</i> Oliv., Garvin Green	128
A New Corixid from Mexico, H. B. Hungerford	133
A New Species of <i>Plebejus Kluk</i> from Idaho, William D. Field	135

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OBSERVATIONS ON *STENOMA MISTRELLA* BUSCK
(STENOMIDAE, LEPIDOPTERA)*H. D. Oliver Miller, Kansas State College¹

Thirteen larvae of *Stenoma mistrella* Busck were collected near Manhattan on brome grass the latter part of May, 1939. One larva was also collected from Kentucky blue grass at Manhattan, the latter part of July, 1939. These brief observations are recorded because the species has not been studied to any extent.

Busck (1906) made the original description of *Stenoma mistrella* from five specimens collected at St. Louis, Mo. Forbes (1933) listed the larva as being found on timothy. He also indicated that the moth was present in July and September and ranged from western Pennsylvania to northern Illinois and Missouri.

The larvae collected by the writer were pinkish-brown with a dark longitudinal stripe on the dorso-median surface (fig.5). They had chestnut brown head capsules (fig. 2) and black cervical shields. The setal pattern (fig. 1) resembled that of *Nomophila noctuella* D. & S.

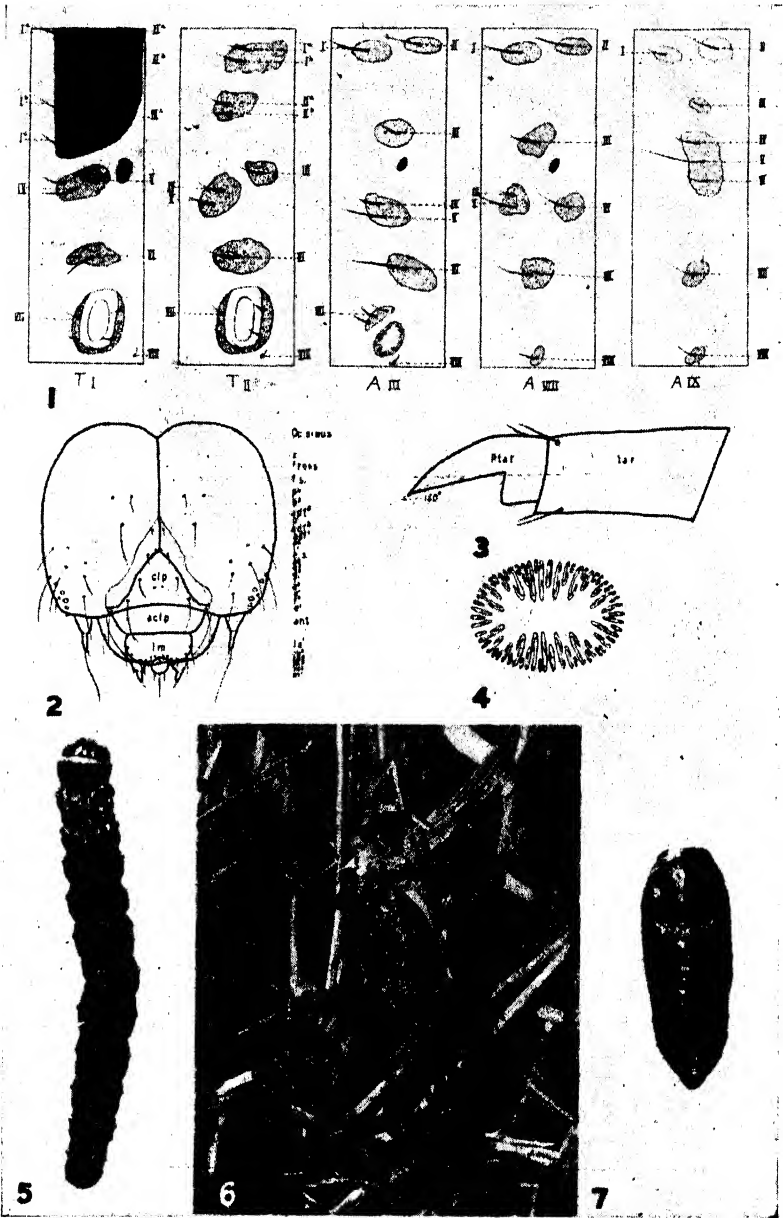
The larvae constructed sheltered tubes at the base of grass plants similar to those of *Crambus* (sod webworm) larvae. The shelter tubes (fig. 6) could be detected by the silken webbing and the pale green fecal material which were present along the upper end of the tube. Usually some blades of grass were incorporated into the sides of the tubes and the upper end was about one inch from the surface of the ground. The larvae were active and moved rapidly either forward or backward. They were also negatively phototropic. Blades of grass in the near vicinity of the shelter tubes were observed to be severely eaten along the sides of the blades. A few of the plants on which the larvae were located were dead.

On June 3, 1939, the first larva pupated and the adult emerged six days later. Five larvae were reared to adults during the course of the season. No definite period of emergence was observed. The last of the larvae pupated during the middle of August, 1939. The average pupal period for the six adults was six days.

The pupae (fig. 7) were light brown in color at first but changed to olive brown within two days. The cremaster was bluntly pointed. The spiracles resembled scars. Four setae of equal length were present on the edges of the cremaster. The six pupae averaged 7.0 mm. in length and 2.5 mm. in width. In the laboratory, the

*Contribution No. 478 from the Department of Entomology.

¹These results were obtained in the course of work on Project No. 115a of the Kansas State Agricultural Experiment Station under the direction of Roger C. Smith.



larvae all pupated within the shelter tubes, but no pupae or empty pupal skins were found in the field.

The adults were identified by Dr. W. T. M. Forbes, to whom the author is greatly indebted. The moths were uniformly light gray in color and the prominent, labial palpi extended over the vertex. The wings were held in roof-like manner over the abdomen. No adults were observed in the fields nor at lights during the season. Other specimens in the departmental collection were collected during June to September in Riley county, at Onaga (F. F. Crevecour) and Abilene (A. B. Klots).

LITERATURE CITED

- Busck, A.—New American Tineina. Ent. Soc. Wash., Proc. 8:93. 1905.
 Forbes, W. T. M.—The Lepidoptera of New York and Neighboring states. Cornell Agric. Exp. Sta. Memoir 68:253. 1923.

Explanation of Plate of *Stenoma mistrella* Busck.

1. Setal map of a full grown larva of *Stenoma* labeled after Heinrich (1918): "Note on the European corn borer (*Pyrausta nubilalis* Hubner) and its nearest American allies, with description of larvae, pupae and one new species." Jour. Agr. Res. 28(3):171-178. Nov., 1918. *Stenoma* larvae differ from *Nomophila noctuella* D. & S. which it most closely resembles in that setae IV and V of abdominal segment A VIII are in front of setae VI, while in *Nomophila* setae IV and V are above setae VI. On abdominal segment A IX, setae I and V are present in *Stenoma* but both are absent in *Nomophila*.
2. Front view of the head of a mature larva of *Stenoma*. The symbols and labeling follow those of Heinrich. Note the small size of the clypeus and the relatively broad, clear area along the dorsal border of the clypeus.
3. A lateral view of pretarsus and tarsus of a thoracic leg of *Stenoma*. Note the shape of the thumb and position of tarsal setae.
4. Chochet of abdominal proleg showing the triordinal hooks which are also typical of *Crambus* sp.
5. A fully grown larva of *Stenoma* (x5). Note the dorso-median dark stripe and the single dark lateral stripe on each side.
6. Shelter tubes on brome grass showing the fine silken webbing, which is characteristic of this species, above the fecal pellets.
7. Dorsal view of the pupa of *Stenoma mistrella* (x8).

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NOTICE OF ANNUAL MEETING

The 16th Annual Meeting of the Kansas Entomological Society will be held March 30, 1940, at the University of Wichita, Wichita, Kansas.

Members wishing to present papers should submit titles to the Secretary not later than February 20, 1940.

H. H. WALKDEN, Secretary-Treasurer
 1204 Fremont, Manhattan, Kansas.

NOTES ON TEXAS PHYLLOPHAGA WITH DESCRIPTION OF ONE NEW SPECIES (COLEOPTERA, SCARABAEIDAE)¹

H. J. Reinhard, College Station, Texas

The following new species has been awaiting description for several years, and with the recent accumulation of additional specimens it now appears desirable to publish the same. The types are in the Texas Agricultural Experiment Station collection.

Phyllophaga sodalis, n. sp.

Form oblong, slightly widened behind, dark castaneous to piceous, surface above glabrous, distinctly shining. Clypeus broadly emarginate, margin narrowly reflexed; punctures moderately coarse, close, well impressed; suture sinuate. Front convex, coarser and more deeply punctate than clypeus. Antennae with ten segments. Thorax irregularly convex above, widest at middle, sides subangulate, serrate; punctures variolate, coarse to very coarse, rather sparsely and irregularly spaced at middle of disc becoming closer at sides and confluent near anterior angles; latter acute. Mesosternum finely, evenly punctured, clothed with shortish, not very thick yellowish hairs. Scutellum with intermixed fine and moderately coarse punctures at sides, disc usually smoother. Legs shining reddish brown, tooth of claw strong, acute, median. Elytra rugulose, punctures fine, not close and rather indistinct; sutural costae well marked, others obsolete or but vaguely defined near apical extremity. Abdomen shiny, with sparse, fine, setiferous punctures at sides, segments five and six more coarsely punctate. Pygidium moderately polished, finely punctured on basal half, more sparsely so near apex and sides.

Length, 18-21 mm.; width, 9-11 mm.

Male. Antennal club distinctly longer than funicle, usually somewhat paler in color. Abdomen broadly flattened at middle; fifth ventral segment with a strongly elevated, broadly arcuate, transverse roughened ridge, posterior to which the segment is sharply declivitous to hind margin; sixth segment deeply, transversely concave, surface roughened at middle, anterior margin obliquely raised at sides. Hind tibia deeply excavated at base of fixed spur; latter convex on inner face, moderately bowed, slender, subacute; outer spur distinctly longer, flattened and broader to apex. Pygidium strongly convex, about one-third broader than long, apex broadly rounded.

Female. Antennal club shorter than funicle. Abdomen hardly flattened on median line; last ventral segment broadly impressed at middle, beset with coarse, decumbent, yellowish hairs, apical margin

¹Contribution No. 558 from the Division of Entomology, Texas Agricultural Experiment Station.

broadly, deeply emarginate. Pygidium noticeably flattened beyond middle above. Hind tarsi distinctly shorter than in male.

Holotype male and Allotype female, Milano, Texas, May 14, 1939 (Ted McGregor). Paratypes: 16 males and 1 female, Milano, Texas, May 14 and 23, 1939 (Ted McGregor); 4 males, College Station, Texas, April 24-May 20, 1930 (H. J. Reinhard); 1 male, Austin, Texas, April 18, 1931, without collector's label; 1 male, Ranger, Texas, May 8, 1935 (H. L. Clearman); 3 males, Pleasanton, Texas, April 24, 1938 (J. E. Gillaspay); 1 male, Stephenville, Texas, April 5, 1938 (Neal Randolph); 2 males and 1 female, Cameron, Texas, April, 1938; May, 1939 (C. E. Heard); 1 male and 1 female in the Kansas University collection, labelled Colorado Co., Texas, April 5 and 10, 1922, U. of K. Lot 1112 and 1113 (Mrs. Grace Wiley).

The species is closely related to *P. prunina* Lec. but differs widely in coloration; the elytra show no trace of pruinosity and are distinctly shiny. Other minor distinctions may be listed as follows: thoracic puncturation sparser, less regular, usually coarser; elytra rugulose; and male antennal club slightly longer. There are no marked differences in the genitalia.

Phyllophaga pleroma, n. n.

Phyllophaga plena Reinhard, Jr. Kans. Ent. Soc., Vol. 12, 1939, pp. 49-51.

I am indebted to L. W. Saylor for calling my attention to the prior use of *plena* by Fall (Jr. N. Y. Ent. Soc., Vol. XL, 1932, p. 199) in *Listrochelus*, which is now considered a synonym of *Phyllophaga*. This synonymy was recently published by Saylor, (Proc. U. S. N. M., Vol. 86, 1939, p. 159).

Phyllophaga renodis Reinhard

Phyllophaga renodis Reinhard, Jr. Kans. Ent. Soc., Vol. 12, 1939, pp. 48-49.

Two additional specimens of this species, including the hitherto unknown female sex, were recently sent to me by M. W. Sanderson for comparison with the holotype. Both examples are from Texas and were taken in August, 1933, at Weslaco and in Cameron County by Dr. S. W. Bromley. They differ from the type in having the elytra wholly black but agree closely in other essential details.

Female. Similar in form to male. Antennae brownish black, club rather slender, hardly exceeding one-half length of funicle. Abdomen evenly convex at middle, surface moderately shining, sparsely punctate at sides; fifth ventral segment with a shallow transverse groove near apical fourth; sixth segment short, hind margin entire. Pygidium transverse, flattened at middle on basal half, coarsely punctate, moderately polished. Hind tarsi shorter than tibiae and hardly as stout as in male. Length, 16 mm.; width, 10 mm.

TELENOMUS OVIVORUS (ASHMEAD), AN EGG-PARASITE OF THE FALSE CHINCH BUG

F. M. Wadley

Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture

Observations on an egg-parasite of the false chinch bug, *Nysius ericae* (Schill.), were made in 1914, when the writer was a seasonal assistant to F. B. Milliken in the Division of Truch Crop and Stored Product Insect Investigations of the Bureau at Garden City, Kansas. Later Mr. Milliken and the writer prepared a manuscript on the species, but it was not published because of doubt as to the identity of the insect. In 1938 the writer found that some of the specimens taken in 1914 were in the National Museum; they were kindly determined by C. F. W. Muesebeck of the Bureau's Division of Insect Identification as *Telenomus ovivorus* (Ashmead). The species was described as *Phanurus ovivorus* from specimens reared from hemipterous eggs collected near Washington, D. C. (Ashmead, 1893), and has apparently not been mentioned in the literature since. According to Mr. Muesebeck the generic name *Phanurus* is now regarded as a synonym of *Telenomus*. The writer and Mr. Milliken observed this parasite only at Garden City, but intensive work was not done at other localities.

The parasite was first noticed in May 1914, reared from an egg of *Nysius*; a few specimens that had been taken in the fall of 1913 were found to be similar. Later numerous specimens were reared, and some adults of the parasite were swept from a variety of plants near swarms of the false chinch bug.

The false chinch bug placed its eggs among trash and plant detritus on the soil, in the cooler part of the season. In summer it moved to plants, placing the eggs among fine parts. In June the *gaillardia* common in the region received many eggs in the flower heads. Later a grass, *Eragrostis*, was favored, eggs being placed in the glumes. False chinch bug adults were abundant early in the summer, became scarce in midsummer, and were seen in only moderate numbers early in the fall.

The parasite tended to follow these ups and downs. In May it was reared sparingly from eggs found on soil. In June it became quite abundant. The flower heads of *gaillardia* containing false chinch bug eggs seemed to afford the parasite a good opportunity. Later in the season the species was again scarce. The eggs in *Eragrostis* were hardly at all parasitized, only one parasite having been reared from this grass. The fact that the glumes closed tightly over the eggs may have been partly responsible. Table 1 will give an idea of the maximum abundance of the parasite.

Table 1.—Rearing data from collections of egg-infested *gaillardia*

Number of flowers	Date collected	Number of <i>Nysius</i> nymphs	Number of parasites
11	June 12	193	77
12	June 24	96	455
3	June 29	3	1

Female parasites oviposited readily in *Nysius* eggs in the laboratory, and development was completed in 11 to 13 days under June temperatures. Collections of flowers continued to yield parasites up to 12 or 13 days after collection. Unfertilized females produced only male progeny; females predominated in field material.

It seems that this parasite might be at times a definite check on the increase of *Nysius ericae* in this region.

LITERATURE CITED

- Ashmead, W. H.—1873. Monograph of the North American Proctotrypidae. U. S. Nat. Mus. Bul. 45.



DISTRIBUTION NOTES ON AMBLYSCIRTES NYSA EDWARDS. (LEPIDOPTERA: HESPERIIDAE)

William D. Field, Lawrence, Kansas*

Heretofore this species has been thought to be native only to Arizona, New Mexico and Texas. This species has also been taken in Scott, Harper, Sumner, Montgomery and Douglas counties, Kansas. In Scott County only the males have been taken and these only late in the fall. The writer has found that it is a rather common species in Douglas County being taken from May through October. Mr. D. Stallings and Dr. Turner of Caldwell, Kansas have taken four pairs of this species during August of 1939, showing that the species is also native to Sumner County. The writer has a specimen from Beaver, Carroll County, Arkansas.

*Contributed from the Department of Entomology, University of Kansas.

NEW CORIXIDATE FROM CHINA, MANCHURIA
AND FORMOSA

H. B. Hungerford, Lawrence, Kansas*

The determination of the Corixidae from the Orient has been exceedingly difficult because of the impossibility of recognizing many species the descriptions of which are inadequate. Recently I have been able to satisfy myself as to the identity of these and submit the following as new.

Sigara crassipala n. sp.

Size: Length 9.6 mm. to 10 mm.; width of head across the eyes, 3 mm.

Color: General facies medium brown. Head, legs and venter yellowish except median part of mesosternum and basal segments of abdomen, which may be more or less embrowned. The pronotum crossed by eight or nine brown stripes which are a little wider than the pale interspaces; the pale figures of the hemelytra broader at base of clavus than elsewhere, transverse, more or less broken and undulate; an irregular dark line between corium and membrane. The faint median carina on anterior part of pronotum often pale, thus dividing first two transverse dark stripes.

Structural Characteristics: Head of male, when viewed from above, a little less than half the length of the pronotal disk, and frontal arch moderately produced. Facial impression of the male oval moderately deep and extending upwards between the eyes but not touching their inner angles; some fine hairs on the face. Interocular space a little narrower than the width of an eye; postocular space narrow, broadest at inner angle of the eye. The third antennal segment is to the fourth as 13 is to 10. Slight longitudinal carina on anterior fourth of pronotum. Surface of pronotum, clavus and most of corium finely rastrate. Lateral lobe of prothorax as shown in figure 10 on plate I. Metaxyphus as shown in figure 4, plate I. Abdominal dorsum as shown in figure 12, plate I. Male genital capsule as shown in figure 2, plate I. The pala characteristically thickened on dorsal side, as shown in figures 1 and 3, plate I. No stridular patch on anterior femur. The measurements of the middle leg as follows: Femur:tibia:tarsus:claws::142:58:40:50. Hind leg measures: Femur:tibia:1st tarsal:2nd tarsal::76:70:85:35.

Described from four males and one female from China in the Francis Huntington Snow Collection, University of Kansas. One specimen from Hou Hu, Nanking 7, 1929. Chi Ping, collector. Three taken by Haas in China. There is a series of 30 of these in the collection at Vienna labeled by me sp. X and a series in "Paris

* Contributed from the Department of Entomology, University of Kansas.

Museum, Se-Tchouen, A David, 1875" which I labeled 2879b, and another series from a different locality labeled 28798, according to my notes. These series in Vienna and Paris I would like to make paratypes, but it is impossible under present circumstances to re-examine them.

Comparative Notes: This species is perhaps more closely related to *S. spatulata* described below than to any other. However, *Sigara ussuriensis* Jaczewski which I have from North Manchuria, *Sigara mandshurica* Jaczewski, a long series of which I have from Manchuria, and *Sigara kolthoffi* Lundb., which I have from China, all belong to the same group of large species. The greatly thickened male pala is like that of *Sigara harrisii* (Uhler) of this country.

***Sigara spatulata* n. sp.**

Size: Length 9.2 to 10 mm.; width of head across the eyes 3 mm.

Color: General facies dark brown. Head, legs and venter pale, except vertex which may be embrowned and the venter which may be more or less suffused with black. The pronotum crossed by seven complete pale bands, often with a short eighth one, these narrower than the nearly black interspaces. The hemelytra marked by narrow, transverse, wavy, pale lines, somewhat broken. At base of clavus the pale bands, as broad as dark ones; elsewhere much narrower. Distal angle of corium bordered by a more or less complete pale V shaped figure.

Structural Characteristics: Head of male, when viewed from above, about half the length of the pronotal disk and frontal arch moderately produced. Facial impression of the male oval, moderately deep and extending upwards between the eyes but not touching their inner angles; some fine hairs on the face. Interocular space about three-fourths width of an eye. Postocular space very narrow except near the inner angle of the eye. The third antennal segment is to the fourth as 13 is to 10. Very slight longitudinal carina on anterior fourth of pronotum. Surface of pronotum, clavus and corium rastroate. Lateral lobe of pronotum as shown in fig. 9, plate I. Metaxyphus slender, elongated, as shown in fig. 8, plate I. Abdominal dorsum as shown in fig. 11, plate I. Male genital capsule as shown in figure 6, plate I. The male pala as shown in figures 5 and 7, plate I. No stridular patch on anterior femur. The measurement of the middle leg as follows: Femur:tibia:tarsus:claws :: 128:50:40:45. Hind leg measures: Femur:tibia:1st tarsal:2nd tarsal::68:70:85:35.

Described from 20 specimens from Manchuria in the Francis Huntington Snow Collections. They are labeled as follows: "Manchuria; Tehli, Lesser Khingan Mts., July 20-24, 1939. A. S. Loukashkin," 1 male and 1 female; "Manchuria Shitonhotze St., Aug.

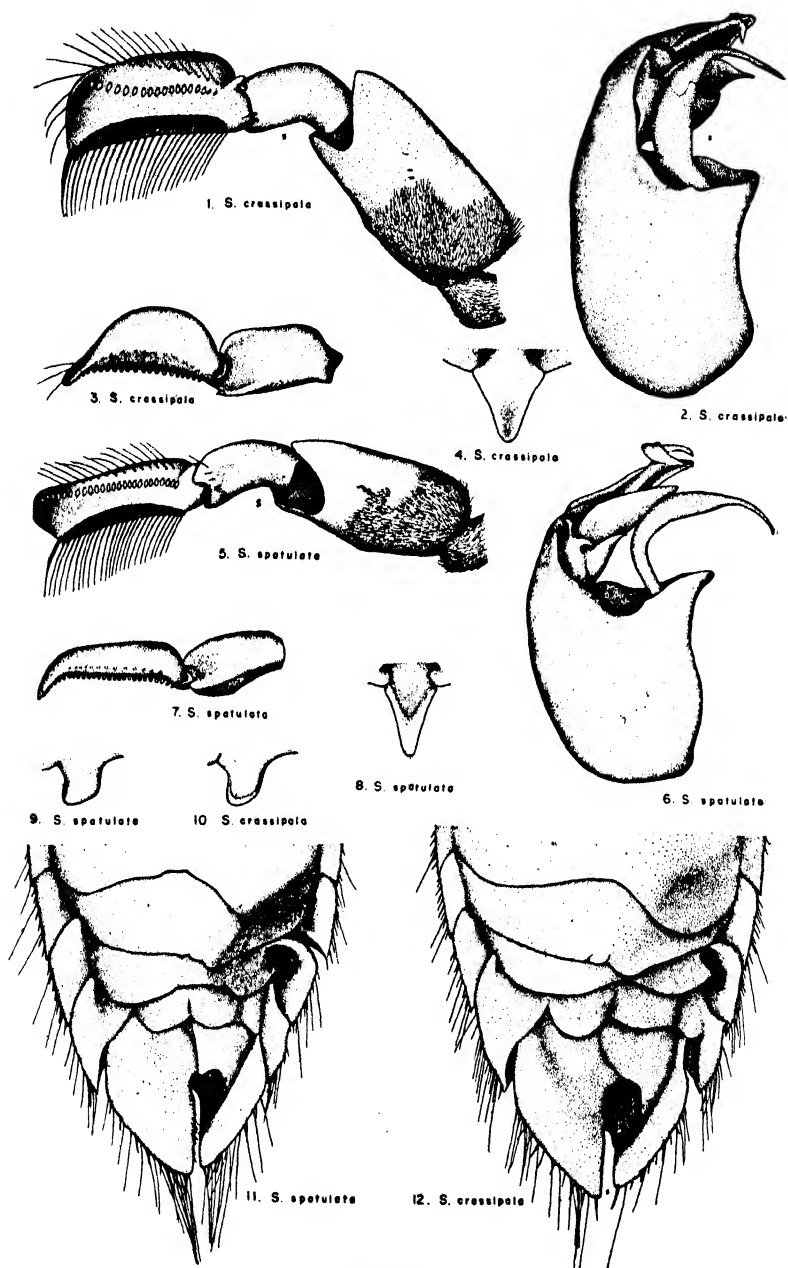


PLATE I

1-15, 1939. A. S. Loukashkin," 5 males and 5 females; "N. Manchuria, Harbin, Sungari River Valley, Aug. 17, 1939. B. Skvortzev," 3 males and 1 female; "N. Manchuria, 100 miles east of Harbin, Aug. 18, 1938. B. Skvortzev," 1 male and 1 female; "N. Manchuria, Cheng Chin, Lesser Khingan, June 22, 1938. A. S. Loukashkin," 1 female; "Harbin, Manchuria, May 18, 1937. M. A. Weymarn," 1 male.

Comparative Notes: This species differs from *S. kolthoffi* by its smaller size, its narrower pale markings of the pronotum and hemelytra and by the shape of the male genital structures.

***Sigara weymarni* n. sp.**

Size: Length 6 mm. to 6.5 mm.; width across the eyes 1.8 mm. to 2.1 mm.

Color: General facies medium brown. Head, legs and venter pale except mesosternum, metasternum and basal segments of abdominal venter may be more or less embrowned or black. The pronotum crossed by about six pale stripes which are sometimes narrower, sometimes broader than the nearly black stripes. The hemelytra marked by transverse, more or less wavy and somewhat broken pale lines. The pale markings at inner angle of clavus broader than elsewhere. A pale line separates corium from membrane; this is bordered on the membrane by a dark band from which arise the dark, wavy transverse figures of the membrane.

Structural Characteristics: Head of the male, when viewed from above, a little more than half the length of the pronotal disk; frontal arch rounded, but little produced. Facial impression of the male shallow, its margin ill-defined. Interocular space a little narrower than the width of an eye; the third antennal segment is to the fourth as 23 is to 20. Slight longitudinal median carina of anterior fourth of pronotum. Pronotum, clavus and anterior half of corium moderately rugulose. Lateral lobe of prothorax as shown in figure 3, plate II. Metaxyphus short, as shown in figure 7, plate II. Abdominal dorsum of male as shown in figure 10, plate II. Male genital capsule as shown in figure 4, plate II. The pala of male with upper basal angle almost right angulate. An oblique depression breaks the row of pegs into series and separates the higher basal level of the palar face from the distal portion. There are from 17 to 19 pegs in each row. A distinct stridular patch on the anterior femur. The pala is shown in figure 8, plate II. The measurements of the middle leg as follows: Femur:tibia:tarsus:claws::86:36:25:30. Hind leg measures: Femur:tibia:1st tarsal:2nd tarsal:: 47:47:57:23.

Described from the following series in the Francis Huntington Snow Entomological Museum of the University of Kansas: 2 males and 4 females labeled "Harbin, Manchoukuo, May 18, 1937. Michael A. Weymarn." (Holotype and allotype are taken from this series);

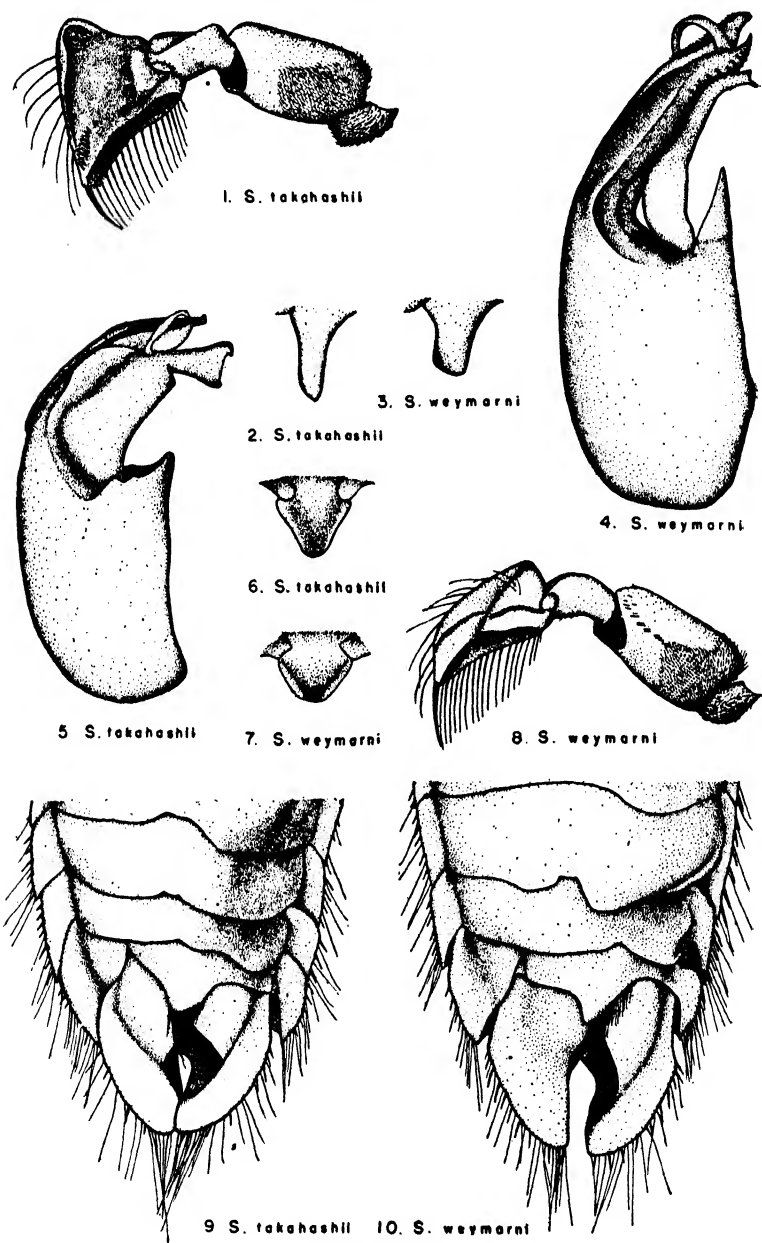


PLATE II

In addition, there are long series from the following places: "N. Manchuria, Asheho River Valley, Sept., 1938. A. S. Loukashkin," and another series taken by M. Nikitin, same place and date; "N. Manchuria Harbin, Sungari River Valley, June 29, 1938. B. Skvortzov"; "Manchuria Shitonhotze St., Aug. 1-15, 1939. A. S. Loukashkin"; "Manchuria, Harbin, Aug. 1, 1938, Marshy lake in Sungari River Valley. M. I. Nikitin."; "Manchuria, Marshy pond in Valley of Asheho River near Harbin under thin ice, Nov. 1-2, 1938. M. I. Nikitin."

Comparative Notes: This species belongs to the subgenus *Subsigara* Stickel and is between *Sigara scotti* (D & S) and *S. falleni* (Fieb.) in size and in the shape of the male pala.

***Sigara takahashii* n. sp.**

Size: Length 6.3 mm.; width across the eyes 2.03 mm.

Color: General facies medium to light. Head, legs and venter pale to yellowish brown with the venter sometimes partly suffused with black. The pronotum crossed by seven or eight brown stripes, slightly narrower than the pale interspaces. The hemelytra marked by wavy, transverse, more or less anastomosing, narrow, brown figures, which cover the membrane also. The membrane but faintly separated from the corium.

Structural Characteristics: Head of male, when viewed from above, two-thirds the length of the pronotal disk, frontal arch broadly rounded and moderately produced beyond the anterior margin of the eyes. Facial impression of the male deep, broad beneath the eyes, margins converging at the inner angle of eyes and the impression definitely narrowed above. The lateral slopes of the depression densely covered with pale hairs beneath the eyes. Interocular space a little wider than an eye; the third antennal segment is to the fourth as 28 is to 20. Faint median longitudinal carina on anterior fourth of pronotum. Dorsal surface of pronotum and hemelytra shining—faintly rugulose. Lateral lobe of pronotum as shown in figure 2, plate II. Metaxyphus as shown in figure 6, plate II. Abdominal dorsum of male as shown in figure 9, plate II. Male genital capsule as shown in figure 5, plate II. The male pala as shown in figure 1, plate II. The patch of hairs on the femur in some views appears in definite rows. The measurements of the middle leg as follows: Femur:tibia:tarsus:claws::80:42:27:38. Hind leg measures: Femur:tibia:1st tarsal:2nd tarsal::45:45:54:22.

Described from 2 males and 2 females from Formosa taken by R. Takahashi and labeled as follows: "Taihoku, Formosa, June 30, 1929" (1 male and 2 females); "Taihoku, Formosa, Aug. 24, 1921" (1 male). Types in Francis Huntington Snow Entomological Collections, University of Kansas.

Comparative Notes: Dr. Matsumura described *C. ishidae* from Formosa from a single female specimen and until male specimens can be definitely associated with it, the species cannot be fixed precisely. The interocular space is narrower and the frontal arch more produced than is *S. takahashii*. Also, the pale figures of the hemelytra are much broader in relation to their transverse length, giving it a distinctly different pattern from the species here described.



A NEW PHYLLOPHAGA (SCARABAEIDAE:COLEOPTERA) FROM JAMAICA

Milton W. Sanderson, University of Arkansas

Phyllophaga darlingtoni n. sp.

Length 13 mm.; width 6.5 mm.

Body elongate, nearly parallel; color above shining brown, the head and prothorax darker than elytra. Head and clypeus moderately and shallowly punctured; clypeal margin rather deeply emarginate and widely reflexed. Prothorax nearly twice wider than long, the sides convergent both anteriorly and posteriorly from the middle. Surface rather finely and evenly punctured. Elytra more coarsely punctured than thorax, the punctures becoming confused near suture in basal one-third of elytra. Discal costa faintly evident, the marginal one obliterated. Pygidium strongly convex, alutaceous, and with scattered punctures, each bearing a fine yellow hair. Abdomen convex, closely and strongly punctured, and each segment bearing a conspicuous transverse patch of yellow hairs. Posterior margin of penultimate abdominal segment with two small triangular teeth separated from each other by width of hind tibia at its middle. Posterior tibia without teeth, and with two slender, movable spurs, the longer one equal to the length of the first tarsal segment, the other about half as long. Claws strongly curved and with a small intra-median tooth. All tarsi very densely clothed with short hairs on lower side. Antenna 8-segmented, the three segmented club longer than the four preceding segments combined.

Holotype male, Mandeville, Jamaica, A. E. Wight. Type in the collection of the Museum of Comparative Zoology, Harvard College.

The claspers are divided, symmetrical, and strongly recurved. This species cannot be compared with any other known West Indian species, and the densely hairy tarsi are quite distinctive.

STUDIES IN NEW WORLD PLECIA
(BIBIONIDAE-DIPTERA)

PART I

D. Elmo Hardy, Lawrence, Kansas*

Comparative studies of the male genitalia throughout the New World *Plecia* have proved that these much neglected structures are of most vital importance in the systematics of this genus. With the exceptions of *americana*, *lopesi* and *nearctica* the species discussed in this paper belong in the so-called "niger" group of *Plecia*; those species in which at least the males are chiefly black.

Plecia americana n. sp.

(Figs. 1a, 1b)

This species is related to *confusa* Loew in having the rostrum much shorter than the head and the thorax entirely rufous. Up to date this has been considered the same as *confusa* but study of the Neotype proved *confusa* to be a tropical species, very different from this common American form. The only marked differences other than male genital characters are its much smaller size and more compact, shortened antennae, the segments of the flagellum being wider than long (with exception of the first segment). The species can be easily separated by the shape of the genital sclerites, it is not necessary to dissect the genitalia to separate it on these characters.

Male genitalia: Ninth sternum deeply concave on posterior margin, cleft about one-half the length of the segment, with a membranous mound in the middle; posterior lateral margins moderately produced; harpagones very small (fig. 1a). Ninth tergum broad, with a small 'v' shaped excision in the middle on the hind margin (fig. 1b).

Male length: body, 4.5-5.5 mm.; wings, 5-6 mm.

Female length: body, 5-6 mm.; wings, 7 mm.

Holotype male, allotype female and forty paratypes, eighteen males, twenty-two females, from Penn., Fla., Apr. 30, 188 (A. S. Stevens), (this locality is probably meant to be Pensacola, Florida). Other paratypes from the following localities:

Florida: two males, one female, Maynard; one female labeled Florida.

Georgia: Saint Simon Island, Apr. 22-May 12, 1911 (J. C. Bradley).

Mexico: San Rafael, V. C. (Townsend); Cordoba (F. Knab).

North Carolina: Littleton, May 12-16, 1902, N. C. Dept. Agri. Cat. No. 306, (bred from larvae in damp rotting wood on under side of log in woods).

* Contributed from the Department of Entomology, University of Kansas.

Texas: One male, one female, Waco (Belfrage); one female, Dallas.

No data: four males, three females.

Dispensation: Holotype, allotype and a large share of the paratypes returned to United States National Museum. Paratypes to be deposited in Snow Entomological Collection, American Museum of Natural History, Philadelphia Academy of Science, Cambridge Museum, Cornell University Collection and North Carolina Department of Agriculture.

***Plectia avicephaliforma* n. sp.**

(Figs. 2a, 2d)

This species is related to *quadrivittata* Williston in having four shining stripes down the mesonotum, the median stripe being divided by a narrow gray line. It differs from this species in having the rostrum shorter than the head; the scutellum opaque (shining in *quadrivittata*); vein R_{2+3} curved or bowed before entering the costa. The male genitalia is very distinctive as is pointed out in the description; the specimens are also slightly smaller.

Male.—Entire black species. **Head:** Antennae nine segmented, the segments short and compressed; rostrum about equal to the antennae in length, shorter than the head. **Thorax:** Opaque, lightly pruinose, except for shining stripes on dorsum; upper portions of sternopleurae with sparse brownish hairs, mesonotal furrows and margins of notum with scattered yellowish hairs. Legs and abdomen with brown to black pile. **Wings:** Brownish fumose, veins dark brown, stigma but slightly darker than the membrane; vein R_1 ends at about two thirds the distance from end of subcosta and R_{2+3} , vein R_{4+5} strongly curved into the costa (fig. 2a). Radio-medial crossvein situated at about the middle of the distance from the m-cu crossvein and the fork of media.

Male genitalia: Sternum rather broad, developed apically into two pairs of small lobes, the lateral pair larger more rounding, the median pair small, sometimes scarcely divided and simulating a single development (fig. 2b). Harpagones simple, with a long beak-like tooth projecting inwardly (avicephaliform) as seen from a lateral view (fig. 2c); scarcely visible from ventral view (fig. 2b). Tegum gently concave with a broad flat topped development medianly (fig. 2d).

Length: body, 3.3-3.7 mm.; wings, 4 mm.

Female unknown.

Holotype male, Diamantina, Minas Geraes, Brazil, Nov. 14-18, 1919 (Cornell University Expedition). One paratype male, same data as type.

Holotype returned to Cornell University, paratype retained in the Snow Entomology Collection.

Plecia edwardsi n. sp.

(Figs. 3a, 3b)

This is a sexually dimorphic species related to *Plecia seminitens* Edwards, the males differing in having the mesonotum almost entirely shining, not divided into stripes by gray vittae, only a small slightly grayed spot behind the humeral ridges and a narrow line of gray along lateral margins of mesonotum. The median groove of the notum is as deep as the lateral ones; the posterior tarsal segments are noticeably swollen and rounding. The genitalia are also very different, *edwardsi* does not have the posterior margin of the ninth tergum nearly straight and the harpagones bilobed as does *seminitens* Edwards. The females differ in having the thorax entirely rufous. Vein R_{2+3} is markedly curved in the males and more oblique in the females.

Male genitalia: Ninth sternum slightly convex on median posterior margin with a mound-like membranous gibbosity in the middle, posterior lateral margins not greatly developed, irregular, with two to three small rounded developments. Harpagones simple and vertical in position, not lateral as in *seminitens*, terminating in a small point apically and a blunt rounded projection in inner side (fig. 3a). Ninth tergum deeply U shaped concave (fig. 3b).

Male length: body, 2.5-3 mm.; wing, 3-3.2 mm.

Female length: body, 2.7-3 mm.; wing 3.5-3.7 mm.

Holotype male, allotype female, three male and two female paratypes: Jussara, Angra Dos Reis, Brazil, Oct. 26, 1935 (S. Lopes et H. Lent).

Holotype, allotype and two paratypes in Snow Entomology Museum, one paratype deposited in British Museum; two paratypes deposited in United States National Museum.

Plecia impilosa n. sp.

(Figs. 4a, 4b)

This species is related somewhat to *grisea* Edwards and *maura* Walker, it differs in coloration and is not so consistently grayed as is *grisea*; the wings are more yellowish and the genital characters are distinctive.

Male.—Chiefly black species. **Head:** Rostrum developed, longer than the antennae, antennae eight segmented; compound eyes not noticeably divided into two portions. **Thorax:** Chiefly bare, with only microscopic hairs on upper portions of sternopleurae and on dorsum. Humeral ridges brick-red; margins of mesonotum, scutellum, metanotum, pteropleurae, metapleurae and hypopleurae with an ochraceous to reddish tinge, this sometimes extends along the mesonotal furrows. Mesonotum chiefly gray dusted, this pruinosity is more distinct on the front sides and in the middle of the furrows; mesopleurae and

sternopleurae grayed, the latter subshining on lower portions. Notum with two rather deep furrows and with a faint median one between, these terminate in a pit-like area just before the scutellum. Legs and abdomen black with dense black pile. **Wings:** Yellow fumose, costal cell and stigma brown, veins dark brown to black; vein R_{2+3} gently curved into the costa.

Genitalia: Ninth sternum broad, posterior lateral margins strongly produced, posterior median margin with a U shaped concavity and a mound-like elevation in the middle. Harpagones rather sharply pointed, as seen from a ventral view (fig. 4a). Ninth tergum deeply concave, the cleft extending over one-half the length of the segment; with a broad, somewhat square protuberance in the center (fig. 4b).

Length: body, 6-7 mm.; wing, 7-8 mm.

Female.—The reddish tinge is more pronounced and more extensive, marking off four opaque black stripes down the dorsum; pleurae entirely tinged; pile even more microscopic; antennae eleven segmented and the wings are more yellow fumose.

Length: body, 8-9 mm.; wing 9.5-10 mm.

Holotype male, allotype female and forty-five paratypes, thirty-two males and thirteen females; West border Matto Grosso, Brazil, May, 1931 (R. C. Shannon).

Holotype, allotype and twenty-six paratypes returned to the United States National Museum. Two males and one female, deposited in the British Museum; one male and one female in the American Museum; two males in Museum of Comparative Zoology at Cambridge, Massachusetts and twelve paratypes retained in the Snow Entomological Collection.

Plecia lateralis n. sp.

(Figs. 5a-5c)

This species is near *grisea* Edwards separating most conveniently by use of the male genitalia; the antennae of the male are nine segmented instead of eight, the furrows of the notum more distinct, humeri and scutellum not reddish tinged, veins R_{2+3} more vertical, the occiput is densely black haired, the sternopleurae with conspicuous dark hairs above and the abdomen dark haired.

Male.—In addition to the above, the rostrum is very thick and pronounced, slightly shorter than the antennae. **Thorax:** Notum rather evenly gray pruinose, slightly more grayed in the furrows and on the margins. Pleurae opaque brown to black; legs and abdomen brown; halteres brownish yellow. **Wings:** Brown fumose, stigma concolorous with the membrane. Vein R_1 ending beyond the middle of the distance from subcosta to vein R_{2+3} ; R_{2+3} almost vertical with but a very slight curve near base; fork of media situated just before middle of distance from r-m crossvein to the fork of R_s .

Genitalia: The ninth sternum is broader than long, with a trough-like concavity in the middle on the hind margin, posterior lateral margins not produced. The harpagones are rather long, appearing simple from ventral view, and more lateral in their position (fig. 5a); in this respect they are more like *Penihetria* than any other *Plecia* which have been observed; from a lateral view an inward developed process can be seen near their bases (fig. 5b). Ninth tergum with a slight convexity in the middle on hind margin (fig. 5c). Entire genitalia densely haired.

Length: Body, 5.5 mm.; wing, 5.5 mm.

Female unknown.

Holotype male, San Miguel, Hidalgo, Mexico, (W. M. Mann). Returned to Cambridge Museum of Comparative Zoology.

Plecia lopesi n. sp.

(Figs. 6a-6c)

This species is related to *bicolor*, differing but little in characters other than those of the male genitalia. The specimens are, however, larger in size, being almost twice the size of *bicolor* and the wings are slightly darker fumose. The dorsum of the thorax is not so shining as in *bicolor* and that of the male is tinged with brownish. The genital characters separate it distinctly.

Male.—**Head:** Rostrum developed slightly longer than the antennae and extending back beneath the face, palpi slender and apparently four segmented. Antennae black, faintly yellowish at bases of segments; eight segmented, first segment longer than second, third slightly longer than first two, fourth, fifth and sixth equal in size, seventh about three-fourth the length of the third, and eighth segment about one-half the width and length of the seventh (fig. 6a). Ocellar tubercle very prominent. **Thorax:** Dorsum dull orange with three rather indistinct longitudinal grooves which converge before the scutellum; pile sparse and microscopic, composed of fine, recumbent brownish hairs; pleurae black with a rufous tinge. Stems of halteres yellow-brown, knobs brownish yellow. Legs very slender, black; pile entirely black. Basitarsi equal to the next three tarsal segments in length, pulvilli bright yellow. Abdomen black with rather dense black pile. **Wings:** Smoky yellow fumose, costal cell and stigma brown; the fork of third vein arising slightly before the end of second vein and slanting gradually into the costa, forming about a sixty-five degree angle with R_{2+3} . Fork of fourth vein arising almost half way between the posterior crossvein and the fork of the third vein. Hind branch of fifth vein fork (Cu_2) curved downward at its apex, anal cell widely opened.

Male Genitalia: Ninth sternum with a sharp triangular shaped projection in the middle on its posterior edge, posterior lateral margins

not greatly developed, claspers broad and rather sharply pointed from ventral view (fig. 6b). Ninth tergum gently and broadly concave on posterior margin (fig. 6c).

Length: body, 6.5-7 mm.; wing, 7.5-8 mm.

Female.—Aside from sexual characters the female differs in having the antennal segments more compacted; the pleurae with a slight reddish tinge. The dorsum of the thorax is more brightly orange, and the specimens are of slightly larger size.

Length: body, 7 mm.; wing, 9-9.5 mm.

Holotype male, Eug. Lefevre, San Paulo, Trav. (Lopes et Oiticica), I-XI-37. Allotype same date. Both in the Snow Entomological Collection.

This species is named after Dr. H. de Souza Lopes who is a very active collector in Brazil. A large share of the Brazilian material studied by the writer has been supplied by Dr. Lobes.

Plecia nearctica n. sp.

(Figs. 7a-7c)

This species is separable from *bicolor* Bellardi only by the male genitalia, these organs, however, possess very distinctive structures. The wings appear to be more consistently darker brown fumose but this would not separate them conveniently. It is a widely distributed species but seems to be more abundant in Southern United States. The species is easily recognized by the development of the ninth sternum and harpagones.

Male genitalia: Ninth sternum somewhat narrowed distally with a small concavity on the posterior margin in the middle (fig. 7a). Claspers bilobed, both arms terminating in a "beak-like" point; the outer lobe is much stouter and vertical in position, visible from dorsal view (fig. 7a); the inner lobe is smaller, more narrow and horizontal in position, directing inwardly and visible only from a lateral view (fig. 7b); the claspers are densely haired. The ninth tergum is gently concave on the posterior margin (fig. 7c).

Length: body, 4-5 mm.; wing, 4.5-5.3 mm.

Female.—The female is inseparable from *bicolor* except on a basis of geographical distribution or accompaniment of the male. The female of *nearctica*, however, have the wings more blackish fumose and the antennae are more compressed, the segments being shorter and broader, but these characters may be subject to variation.

Length: body, 5-6.3 mm.; wing, 5.5-7.3 mm.

This species is widely scattered but is apparently more common in Texas and Louisiana.

Holotype male and allotype female on same pin, Galveston, Texas May (F. H. Snow). Over one hundred and fifty paratypes from the following localities:

Costa Rica: one male, Dec. 1911 (W. M. Wheeler).

Guatemala: one male, Patulul (M. Bates); one male, one female, Puerto Barrios.

Honduras: one female, No. 503, 1921.

Louisiana: two males, two females, Vinton, fourteen miles south, Sept. 5, 1916 (E. G. Holt); four females, seven males Crowley, Aug. 24, 1911 (E. S. Tucker); five males, six females, Gueydan, May 4, 1925 at light (E. Kalmbach); seven males, five females, Morgan City, April 17, 1938 (John Standish); twelve males, fourteen females, Banton Rouge, May 12, 1934 (Lyman).

Mexico: one male labeled Mex.; one male, State of Colima (L. Conradt); one male, one female, Tehuantepec, Oaxaco; one male, one female, Ciudad, Vict. Tamps, May 15, 1937 (A. Stone); one male, two females, Yucatan (G. F. Gaumer).

Mississippi: one male, two females, Moss Point, Sept. 17, 1937 (G. L. Bond).

Texas: three males, three females, same data as type; one male, one female, Bexar Co., May 12, 1930; two males and one female, Colo. Co., May 11, 1922 (G. O. Wiley); one male, one female labeled Texas; five males, nine females, Orange, Sept. 4, 1916 (E. G. Holt); three females, one male, Dickenson Co., May, 1929 (F. M. Hull); twelve males, fourteen females, Brownville, May-June, by various collectors (Barber, Vickery, Webster, Mitchell and Hinds); one female, Houston, April 28 (Barber); two males, seven females, Victoria, April-Sept. on *Pluchea* sp. and *Ambrosia psilostachya* (Mitchell, Hinds).

Distribution of types: Holotype, allotype and a share of paratypes in the Snow Entomological Collection; other paratypes being deposited in United States National Museum collection, American Museum, Oklahoma A. and M. College, British Museum of Natural History, Cambridge Museum of Comparative Zoology, Philadelphia Academy of Science, Cornell University and Texas A. and M. College.

Plecia persimilis n. sp.

(Figs. 8a-8c)

This species is very similar to *seminitens* Edwards and fits the original description of that species in most details. Dr. Edwards has compared a specimen with the type of *seminitens* and has kindly sent the writer a metatypic male for study.

In general characteristics these species are identical, however, the wings of *persimilis* are yellow to yellow-brown fumose instead of dark smoky fumose as in *seminitens* and the legs are rather consistently rufescent tinged. The more important differences are in the genital structures. The posterior median margin is not produced as in *seminitens* and the harpagones not so thickened and blunt apically.

The harpagones are divided into two lobes, the inner being much smaller and located beneath the outer; harpagones rather narrow from a lateral view and only the large outer lobe is visible (fig. 8a). Ninth sternum with a small 'u' shaped cleft in the middle on posterior margin (fig. 8b). Tergum with a flat topped development projecting much beyond hind margin (fig. 8c).

Length: body, 2.8-3.5 mm.; wing, 4-4.2 mm.

Female unknown.

Holotype male, and six paratype males; San Paulo—Cantareira, (Serra) Brazil, July 9, 1934 (L. Trav. fo.).

Holotype and three paratypes returned to United States National Museum. One paratype presented to British Museum of Natural History and two retained in the Snow Entomological Collection.

***Plecia pruinosa* n. sp.**

(Figs. 9a, 9b)

Allied to *grisea* and *lateralis* but the males possess very distinctive genital structures. They may be distinguished without dissecting the male genitalia by their longer, not so thickly built rostrum, somewhat pale based femora (yellowish in female), black halteres and smoky brown fumose wings.

Males.—**Head:** Pruinose, rostrum produced as long or longer than the antennae; antennae nine segmented, counting nipple-like tip; occiput densely black haired. **Thorax:** Entirely pruinose, more grayed in the furrows and on the margins. Notal furrows distinct, humeral ridges yellow-red, humeri with patches of long black hairs; sternopleurae with only a few pale hairs above. Legs and abdomen brown to black, bases of femora slightly yellowed; pile of abdomen yellow-brown. **Wings:** Vein R_{2+3} gently curved into costa, fork of media before one-half the distance from r-m crossvein to fork of R_s . Stigma slightly darker than the wing membrane.

Genitalia: Posterior margin of ninth sternum developed into a pair of heavily sclerotized, outward projecting, clasper-like lobes and a pair of smaller, rounded lobes on posterior lateral margins. Harpagones comparatively small and situated toward the middle of the sternum, scarcely visible from ventral view, arising from behind the membranous area and with two acute points apically (fig. 9a). Tergum with a V shaped excavation in the middle of the hind margin, two obtuse points sloping inwardly at apex of tergum (fig. 9b): the hind margin is developed into a broad strongly sclerotized shelf-like area extending into the genital chamber, probably giving support to the anal area.

Length: body 4.5 mm.; wing, 5.2 mm.

Female.—The scape, pedicle and bases of first flagellar segments are yellow; the entire thorax is faintly yellowish tinged, the margins

and humeral ridges are distinctly yellow, as are the trochanters and femora; otherwise like the male.

Length: body, 4.6 mm.; wing, 5.6 mm.

Holotype male, allotype female and two paratypes, one male and one female, Pico Turquino, Cuba, June 16-21, 1936, 6000 ft., (summit) (Darlington). One female is also on hand which appears to be this species from Whitfield Hall, Blue Mts., Jamaica, 4500 ft., Aug. 13-20, 1934 (Darlington), but as no male accompanies it the writer prefers not to set it up as a paratype.

Holotype, allotype and one paratype returned to the Cambridge Museum of Comparative Zoology, others retained in the Snow Entomological Collection.

***Plecia punctulata* n. sp.**

(Figs. 10a, 10b)

Somewhat related to *nitidipes* Edwards but differing in a great many respects. The rostrum is developed as long or longer than the antennae; the dorsum is covered with minute punctules; the ninth sternum is not developed into two pairs of lobes on hind margin and the posterior lateral margins not at all produced; the tergum is not so deeply concave and the lateral margins are developed into a pair of narrow lobes posteriorly (fig. 10b).

Male.—In addition to the characters given above: Entirely black, opaque to sub-opaque, dorsum sometimes in part shining and usually appearing faintly pruinose, especially on the margins, this appearance is caused by the finely punctulate texture. Stems of halteres yellow-brown, knobs brown to black. **Wings:** yellow-brown fumose, veins and stigma brown; vein R_{2+3} gently curved into the costa; crossvein r-m situated at about the middle of the distance between m-cu and fork of media.

Genitalia: Ninth sternum scarcely developed on hind margin, only two small swellings toward the middle. Harpagones elongate and strong, produced about as long as the sternum and rather abruptly tapering on the inner margins near their apices (fig. 10a). Ninth tergum divided into two halves by a median groove or invaginated area; posterior lateral margins produced into a pair of narrow lobes; median margin with a strong pointed process (fig. 10b) which folds inward toward the genital chamber.

Length: body, 3.2-3.6 mm.; wing, 3.7-4 mm.

Female.—The stigma is concolorous with the wing membrane, vein R_{2+3} more oblique, curved but slightly near its base; antennae eleven segmented; humeral ridges and hind margins of mesonotum tinged with rufous; otherwise like the male, except for sexual characters.

Length: body, 4-4.3 mm.; wing, 4.6-5 mm.

Holotype male, allotype female and four paratypes (two males,

two females) Diamantina, Minas Geraes, Brazil, Nov. 14-18, 1919, (Cornell Univ. Exped.).

Holotype, allotype and two paratypes returned to Cornell University, two paratypes retained in Snow Entomological collection.

Plecia rufimarginata n. sp.

(Figs. 11a, 11b)

This species is near *edwardsi* n. sp., it can readily be separated by the rostrum being produced as long as the antennae and the difference in the male genitalia; the pleurae, sides and hind margin of the notum are tinged with reddish in the males and the legs of both sexes are tinged with yellowish brown. The hind legs are broken off the holotype so the shape of the posterior tarsi is not known, The fork of the media is located at about one-half the distance between the r-m crossvein and the fork of the Rs, instead of at the basal one-third as in *edwardsi*. This is the smallest species known to the writer from the New World.

Male Genitalia: Ninth sternum slightly wider than long, posterior margin concave with three median projections; the two lateral ones are heavily sclerotized, vertical in position and densely haired; the median is more membranous and projects inward toward the genital chamber and is bare (fig. 11a). The harpagones are simple and terminate in an acute point on the inner margins. Ninth tergum with but a single concavity on posterior margin (fig. 11b).

Male length: body, 2.1-2.3 mm.; wings, 2.6 mm.

Female length: body, 2.6-2.7 mm.; wings, 3.2 mm.

Holotype male, Paraiso C. Z., Panama, Feb. 6, 1911 (E. A. Schwartz). Allotype female same data. Both returned to the United States National Museum.

Plecia rufiscutella n. sp.

(Figs. 12a, 12b)

This species approaches *nitidipes* Edwards but is very different from that species. Both sexes can be easily recognized by the bright orange-red scutellum; the mouth parts are much longer and the wings differ; they are larger in size and the male genitalia is distinctive. In general appearance they seem near *impilosa* n. sp. but the genital structures place them nearer *nitidipes*.

Male.—Head: Rostrum produced longer than the head, antennae broken on holotype specimen. **Thorax:** Opaque black with a faint reddish tinge on the lateral margins; scutellum bright orange-red. Almost bare species, with only brown hairs on the upper portions of the sternopleurae and a dense patch of black hair on each humeri. Mesonotal furrows very faint, sides and hind portions of notum rugose; the rugosity appearing in sunken areas, one on each side and one just before the scutellum. **Legs and abdomen** subshining

black with black pile; halteres black. **Wings:** The wing venation is much the same as in *plagiata* Wiedemann but the fumose borders of the veins are more yellowish and not so dark. Vein R_{2+3} gently curves into the costa. R_1 is situated two-thirds the distance between subcosta and R_{2+3} ; fork of media at or slightly beyond one-half the distance from the r-m crossvein to the fork of R_s .

Genitalia: Ninth sternum very broad and rather long, posterior lateral margins produced into two large flat-topped lobes, posterior median margin with two narrow processes. Harpagones very slender and elongate, vertical in position (fig. 12a). Ninth tergum concave on hind margin, posterior lateral margins with a distinct emargination, anterior margin very deeply cut inward almost dividing the segment (fig. 12b); cerci very broad and rounding.

Length: body, 7.5 mm.; wing, 9.5 mm.

Female.—Antennae eleven segmented, thorax brownish with a faint shade of red; scutellum yellow-orange; legs slightly reddish tinged, otherwise like the male.

Length: body, 8-9 mm.; wing 12 mm.

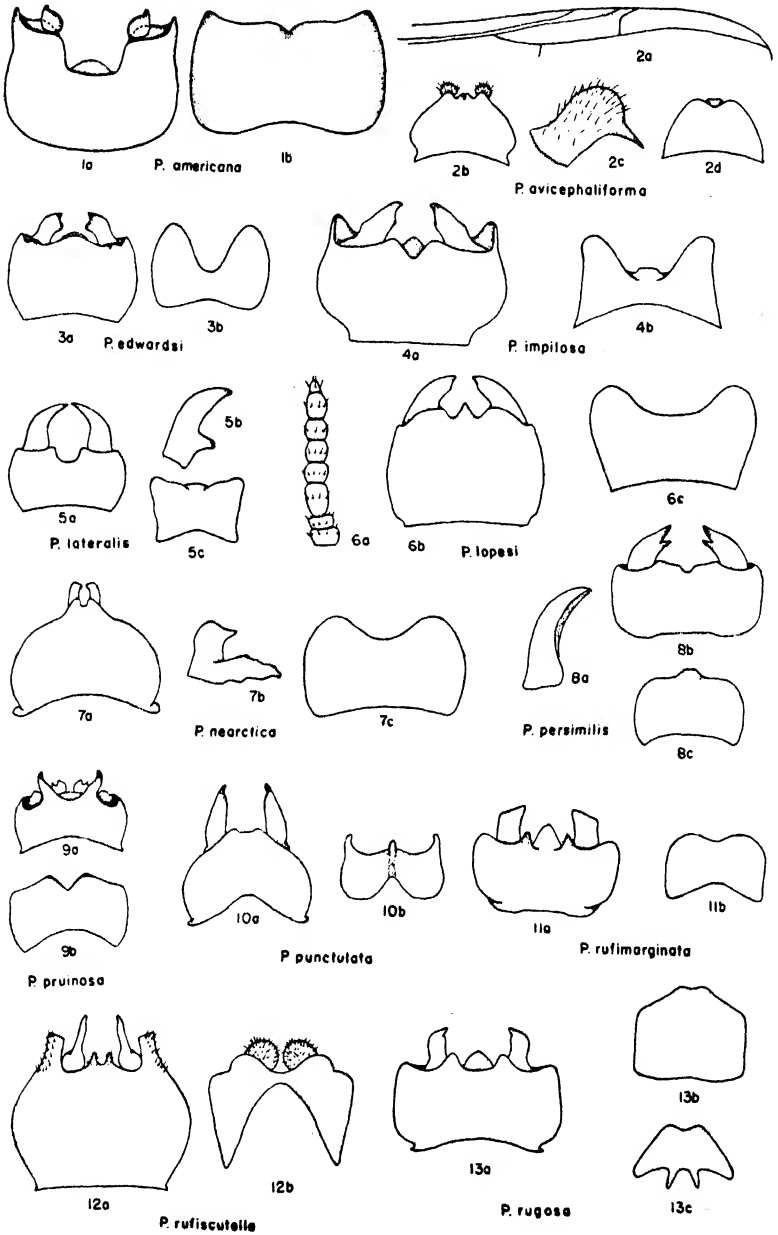
Holotype male and allotype female, Moyombamba Region, Peru, Jan. 8, 1926, f. 6144 (H. Bassler). Both returned to American Museum.

Plecia rugosa n. sp.

(Figs. 13a-13c)

This species seems to approach *rufimarginata* n. sp. in general characters but can be easily separated by the finely shagreened surface of the mesonotum, its slightly larger size and very different genitalia.

Male.—**Head.** Rostrum produced about as long as antennae, folded beneath the face; antennae nine segmented the segments short and compressed. **Thorax:** Mesonotum shining, entire surface finely shagreened, somewhat more coarsely so on the lateral and anterior margins, more smooth posteriorly. Mesonotal furrows very distinct, terminating in a small depressed area just before the scutellum. Dorsum almost bare, a few scattered yellow hairs on the margins of the notum. Pleurae chiefly opaque, upper portions of sternopleurae also shagreened, with numerous long brown hairs; lower portions of sternopleurae shining and bare. Halteres black, stems yellow-brown. Legs and abdomen dark brown to black covered with long black pile, tarsal joints slender. **Wings:** Uniformly yellow-brown fumose, stigma but little darker than membrane, veins brown; fork of third vein (R_{2+3}) curved moderately into the costa; fork of media situated just before one-half the distance from the r-m crossvein to the fork of the radial sector. Vein Cu_2 scarcely sloped downward at its tip, anal cell as wide at apex as at middle.



Genitalia: Ninth sternum broader than long, posterior lateral margins not developed; hind margin with two moderately developed erections having a U shaped concavity between them; median portion developed into a somewhat membranous area which fits above the aedeagus. Harpagones with a somewhat beak-like point apically, on inner side (fig. 13a). Ninth tergum about as long as wide, narrowing somewhat on apical one-third, hind margin with a small indentation (fig. 13b); hind margin of tergum developed inwardly to form a broad plate before the anal region, as seen from lateral or end view; this plate terminates in two strongly sclerotized, inward projecting points (fig. 13c).

Length: body, 3-3.3 mm.; wing, 3.5 mm.

Female.—Differs from the male in having the thorax entirely rufous and abdominal sterna lightly tinged with yellowish and first two antennal segments yellow.

Length: body, 4.5 mm.; wing, 4.6 mm.

Holotype male, allotype female and two paratype males, Bet. Queremal and Buenaventura, alt. 3500-4000 ft. Columbia XII-11-1935 (Herbert F. Schwarz). Holotype, allotype and one paratype returned to American Museum, one paratype in Snow Entomological Collection.

EXPLANATION OF PLATE

- Fig. 1. *Plecia americana* n. sp.
Male Genitalia: a. ventral, b. dorsal
- Fig. 2. *Plecia aviccephaliforma* n. sp.
a. Wing. Male Genitalia: b. ventral, c. lateral of harpagone, d. dorsal.
- Fig. 3. *Plecia edwardsi* n. sp.
Male Genitalia: a. ventral, b. dorsal.
- Fig. 4. *Plecia impilosa* n. sp.
Male Genitalia: a. ventral, b. dorsal.
- Fig. 5. *Plecia lateralis* n. sp.
Male Genitalia: a. ventral, b. lateral of harpagone, c. dorsal.
- Fig. 6. *Plecia lopesi* n. sp.
a. antenna. Male Genitalia: b. ventral, c. dorsal.
- Fig. 7. *Plecia nearctica* n. sp.
Male Genitalia: a. ventral, b. lateral of harpagone, c. dorsal.
- Fig. 8. *Plecia persimilis* n. sp.
Male Genitalia: a. lateral of harpagone, b. ventral, c. dorsal.
- Fig. 9. *Plecia pruinosa* n. sp.
Male Genitalia: a. ventral, b. dorsal.
- Fig. 10. *Plecia punctulata* n. sp.
Male Genitalia: a. ventral, b. dorsal.
- Fig. 11. *Plecia rufimarginata* n. sp.
Male Genitalia: a. ventral, b. dorsal.
- Fig. 12. *Plecia rufiscutella* n. sp.
Male Genitalia: a. ventral, b. dorsal.
- Fig. 13. *Plecia rugosa* n. sp.
Male Genitalia: a. ventral, b. dorsal, c. end view of ninth tergum.

NEW RECORDS OF BUTTERFLIES FOR KANSAS
(LEPIDOPTERA: RHOPALOCERA)

William D. Field, Lawrence, Kansas*

The following is a list of butterflies, all new records for Kansas, that because of their abundance, or for other reasons, are regarded by the writer as being native to the state.

Asterocampa clyton subpallida (Barnes & McDunnough). One female specimen of this subspecies of *A. clyton* has been taken in Douglas County, two have been taken in Leavenworth County and another was taken a number of years ago in Bourbon County.

Calycopis beon (Cramer). This species, recently recorded from a large number of Texas specimens as being new to the United States¹ has recently been taken in Sumner County, Kansas by Mr. D. Stallings and Dr. Turner.

Strymon ontario ontario (Edwards). Three specimens of this, all in good condition, have been taken in Greenwood and Douglas counties. The Douglas County specimen was taken on June 10th, 1934.

Strymon alcestitis (Edwards). A freshly emerged male of this species was taken in June of 1938 and another specimen, a perfect, female, was taken in July of the same year.

Mitoura gryneus (Hübner). A half dozen specimens of this species were taken during July a great number of years ago by E. A. Popenoe in Riley County, Kansas.

Lycaena phlaeas hypophlaeus (Bdv.). This species has been taken in Scott, Pottawatomie and Douglas counties. In Douglas County about twelve specimens were captured on October 9th, 1932. Numerous other specimens were observed but were not taken as the species was thought to be very common. It has not been observed since.

Anthocharis midea (Hübner). Douglas and Leavenworth counties. This butterfly was observed for the first time during April of 1938. It is apparently rather abundant in these two counties and is undoubtedly found throughout eastern Kansas.

Achalarus lyciades (Geyer). Found for the first time several years ago in Leavenworth and Douglas counties during the latter part of May. It is apparently a common species, having been taken every season since the date of its first capture.

Erynnis persius (Scudder). Taken in Scott and Douglas counties.

Erynnis lucilius (Scudder & Burgess). Several specimens of this species have been taken during September in Douglas County.

Erynnis baptisiae (Forbes). A female of this species was taken

*Contributed from the Department of Entomology, University of Kansas.

¹In manuscript.

in July, 1932 in Douglas County. A male was taken in Leavenworth County on June 14, 1936. It will probably be found to be more common than these records indicate, but it has only just recently been described¹ and has not been searched for along the western edge of its range. The specimens of this species and of both of the above were determined by Dr. W. T. M. Forbes, the latest reviser of the group.

Polites mana'aaqua (Scudder). This species has been taken in Riley, Mon'tgomery and Douglas counties. It is rather abundant in the last two counties but is not as abundant as the closely related **Polites themistocles** (Latreille).

Catia otho egeremet (Scudder). Rather common in Douglas County and is undoubtedly found throughout most of eastern Kansas.

Poanes zabulon (Bdv. & LeC.). This species has been taken in Greenwood, Douglas and Pottawatomie counties and is rather common during the latter part of May and the first week in June in Douglas County.

Atrytone ruricola (Boisduval). Douglas and Pottawatomie counties. It is rather common in Douglas County and will probably be found to occur over most of eastern Kansas.

¹Psyche, 43, p. 111, 1936.

SOME UNUSUAL BUTTERFLY RECORDS FOR KANSAS
(LEPIDOPTERA: RHOPALOCERA)

William D. Field, Lawrence, Kansas*

The following is a list of butterflies, all new records for Kansas, that because of their rarity or because of circumstances preceeding their capture should be regarded as wind blown specimens or strays that are far out of their normal range.¹ All are typically western, southern or southwestern species.

Heterochroa bredowii bredowii (Geyer). A single female, in excellent condition was found fluttering around Boxelder (*Acer negundo* L.) on May 2nd, 1936 by V. F. Calkins near Scott City, Kansas. This species is normally found from Arizona south through Mexico to Guatemala.

Asterocampa celtis alicia (Edwards). This species which ranges from Texas through the Gulf States to Florida, has been taken as a stray in Crawford County.

Melitaea fulvia (Edwards). A single specimen of this typically southwestern species was taken on June 28, 1912 in Rush County by F. X. Williams.

Everes comyntas herrii (Grinnell). Stray specimens of this western subspecies of *Everes comyntas* (Godt.) have been taken in Scott County by V. F. Calkins.

Glaucopsyche lygdamus oro (Scudder). One specimen of this species was taken by R. Christy in Scott County during the spring of the year. *Oro* is found typically in the Rocky Mountains of Colorado.

Appias ilaire poeyi Butler. A male and female of this species were taken on August 2nd and August 3rd of the past year in Greenwood County by Mr. Edward Todd.

Pyrgus communis albescens Plotz. This southwestern subspecies of *Pyrgus communis* (Grote) has been taken in Scott County by V. F. Calkins.

Yvretta rhesus (Edwards). This species which inhabits parts of Arizona, New Mexico and Colorado, has been taken in Scott County, where it is very rare.

Hesperia viridis (Edwards). Two male specimens of this western species have been taken in Scott County State Park by R. Christy.

Hesperia attalus (Edwards). A single male specimen of this species has been taken by Dr. R. H. Beamer in Montgomery County.

*Contributed from the Department of Entomology, University of Kansas.

¹For additional records of wind blown specimens or strays see: V. F. Calkins, "Some Unusual Butterfly Records Taken In Scott County Kansas." Bull. Brook. Ent. Soc., vol. XXXI, no. 2, pp. 66-68, April, 1936.

It is typically an eastern and southern species.

Atrytone logan lagus (Edwards). A single specimen of this species has been taken in the Scott County State Park. It is native to parts of Texas, Colorado and Wyoming.

Calpodes ethlius (Cramer). This species is found from Argentina and Brazil in South America north through Central America, Mexico and the West Indies into Florida and Texas. It occasionally strays further northward in the United States and sometimes is taken as far north as St. Louis, Missouri and Long Island, New York. A single specimen was taken in Douglas County, Kansas on May 9th, 1911 by F. X. Williams.

Libythea bachmanii larvata (Strecker). A single wind-blown female of this species was taken in Greenwood County by Edward Todd on August 3rd, 1939.

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CONTENTS OF THIS NUMBER

Observations on <i>Stenomus Mistralla</i> Busck (<i>Stenomidae</i> , <i>Lepidoptera</i>), H. D. Oliver Miller	1
Notice of Annual Meeting, H. H. Walkden, Secretary-Treasurer	3
Notes on Texas <i>Phyllophaga</i> with Description of One New Species (<i>Coleoptera</i> , <i>Scarabaeidae</i>), H. J. Reinhard	4
<i>Telenomus Ovivorus</i> (Ashmead), an Egg-parasite of the False Chinch Bug, F. M. Wadley	6
Distribution Notes on <i>Amblyscirtes Nysa</i> Edwards. (<i>Lepidoptera</i> : <i>Hesperiidae</i>), William D. Field	7
New <i>Corixidae</i> from China, Manchuria and Formosa, H. B. Hungerford	8
A New <i>Phyllophaga</i> (<i>Scarabaeidae</i> : <i>Coleoptera</i>) from Jamaica, Milton W. Sanderson	14
Studies in New World <i>Plecia</i> (<i>Bibionidae</i> - <i>Diptera</i>), Part I, D. Elmo Hardy	15
New Records of Butterflies for Kansas (<i>Lepidoptera</i> : <i>Rhopalocera</i>), William D. Field	28
Some Unusual Butterfly Records for Kansas (<i>Lepidoptera</i> : <i>Rhopalocera</i>), William D. Field	30

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STARLING ATTACKS UPON WARBLE INFESTED CATTLE IN THE GREAT PLAINS AREA¹

Arthur L. Goodrich, Jr.

Introduction

The European Starling (*Sturnus v. vulgaris* Linnaeus), introduced successfully into the United States about 1890, is a member of an old-world family of birds. Its close relatives are indigenous to Africa, Europe, India and adjacent areas. There are approximately 70 known species belonging to about 20 genera in this family. Near relatives of the starling, termed mynahs, may now be nesting in the wild state near Los Angeles, California, and in the Pacific Northwest (Ryan, 1930).

This paper has been written in an effort to present a record of the attacks of starlings upon cattle of which only incomplete and rather garbled accounts have been published in the press.

Starlings are about eight and a half inches long, possess a slender beak as long as the head, and have metallic purplish or greenish plumage. Many of the feathers are tipped with buff and appear thus in winter, but the tips wear off, so that by late spring there may be little evidence of buff. Birds less than a year old tend to show much more buff and have whiter underparts than older specimens. The tail is short and square. They are essentially ground feeders, subsisting upon an omnivorous diet of grubs, caterpillars, worms, fruits, berries, and other foods. They mate among the earliest of the song birds, constructing nests of grass, twigs, and related materials, in holes in trees, or in protected places. The female lays from four to seven pale blue eggs, and may rear two broods a year.

Introduction and Spread

The presence of starlings in the United States is believed to be the result of releasing two groups totaling about 100 birds in Central Park, New York City, in 1890 and 1891. Records indicate starlings were first released in the United States at Cincinnati, Ohio, in 1872 (Collinge, 1937). The birds apparently did not become established at this time. Subsequent importations were made into New York in 1877, and at Portland, Oregon, in 1889 and 1892. Starlings in the Pacific Northwest are possibly the descendents of these importations into Portland. It is possible that unsuccessful importations date back to 1850 (Stack, 1933). About 1909, the Secretary of Agriculture used his powers to place the name of the European Starling upon the list

¹Contribution No. 214 from the Department of Zoology, Kansas State College, Manhattan, Kansas. The author wishes to acknowledge the assistance of members of the Department of Entomology, Kansas State College, in gathering the data for this paper.

of animals to be denied entrance into the United States by the Customs officials.

As a result of the successful importations of 1890 and 1891, starlings became numerous around Greater New York City by 1900. Their rapid spread from this focus was hindered by severe winter conditions and by lack of an instinct to migrate in their new environment. Gradually, however, they spread westward and southward, crossing the Allegheny mountains by 1916, for a specimen was taken at West LaFayette, Ohio, in January, 1916 (Hicks, 1933). In 1928 the breeding range, where starlings were present in sufficient numbers to be of economic significance, was said to be from southern New England to Virginia, west to central Pennsylvania and western New York (Cook, 1928).

Starlings were found at Ypsilanti, Michigan, in 1922, and are said to have been found in Illinois the same year (Baker, 1937). They were first found nesting in Madison County, Indiana, in 1927. Starlings were reported from Tulsa and Norman, Oklahoma, during severe weather in December, 1929, and January, 1930 (Chase, 1930), and from at least two areas in Kansas in the early months of 1930 (Davidson, 1933, and Bunker, 1930). Wetmore (1933) reported the westernmost extension of their range in 1932 as Bridgeport, Oklahoma, and Strawn, Texas. Starlings were identified on a Utah ranch in February, 1939 (Condor, 41(4):170, 1939).

Economic Status

Opinion differs among ornithologists of this country and abroad as to the economic status of the starling. Allen (1934), in one of his inimitable autobiographies of birds, makes the starling say: "In deed, those who are not raising cherries or berries have every reason to thank the good man who brought us over to this country which needs our services so badly." Collinge (1937) records that the balance might be considered to be on the beneficial side in the United States and Canada, but that in England, where maximum numbers seem to have been attained, they are considered a pest. Collinge adds that the United States must control the numbers of starlings to obtain benefit from their presence. Pitt (1935), writing in an illustrated English farm journal, considered the beneficial against the detrimental attributes of the starling and came to the conclusion that the bird is a blessing. Chapman (1907) has written that Americans have been warned by European ornithologists that the birds may become injurious to grain fields. At that time, Chapman seems to have considered the bird of less potential danger than the English sparrow, for he wrote, "The Starling is not so prolific, hardy or adaptive as that 'rat of the air,' the Sparrow. . ."

The berry-eating and fruit-pecking habits of the bird, coupled

with its known proclivity to drive out native species of hole-nesting birds and usurp their breeding places, are detrimental activities. Its tendency to flock, sometimes in large numbers, around our business and civic buildings, is well known in the Eastern States. The fact that the bird feeds upon grubs, grasshoppers, weevils and other pests of the farm, orchard, and truckgarden, is a beneficial attribute. Kalmbach (1937) calls our attention to the information that the starling is "recognized as one of the most effective bird-enemies of ground-inhabiting insects of the Eastern States."

Starlings and Cattle

It is the omnivorous nature of the feeding habits of the starling that has recently caused some alarm in the Middle West. Out of Kansas, Oklahoma, and Nebraska have come reports of starlings alighting upon the backs of cattle, ostensibly to remove ox warbles¹. Alexander (1934) reported starlings followed cattle on a farm near Wellington, Kansas, in February, 1934, but makes no mention of the birds alighting upon the backs of the cattle. Through the winters of 1937 and 1938 the county agents of Chase and Comanche Counties, Kansas, received reports from stockmen that starlings were apparently probing the breathing apertures of ox warbles for the maturing grubs within their pits. This information did not reach print, but was reported to the writer and others by Dr. E. G. Kelly, Kansas State College Extension Specialist in Entomology, upon receipt of several letters during January, 1940, by Kansas State specialists that starlings were stampeding and injuring cattle in central Kansas.

Grub-infested cattle are greatly bothered by the attacks of starlings. After having been once attacked, cattle will stampede upon the sudden appearance of starlings. Dr. E. G. Kelly tells of watching a flock of starlings attack a herd of cattle, resulting in a stampede. That the flying birds outstripped the running cattle and turned them by swooping in front of the racing cattle is surprising evidence of the resourcefulness of the starlings in their new undertaking. A Kansas stockman has reported that a number of animals were in-

¹Ox warbles are the immature stages of dipterous insects, *Hypoderma lineata* (De Villers) and *H. bovis* (De Geer), whose life cycles include a period of parasitic existence in tumors under the skin of cattle. The adult females deposit eggs upon hairs, generally near the fetlocks, from which point the hatched larvae drill through the skin to wander through the tissues of the host, finally to become lodged under the skin, usually in the loin region. At this site, each larva or warble drills an aperture through the skin, permitting the larva to take atmospheric oxygen into its respiratory system. After repeated ecdyses, the mature larva leaves its pit through the respiratory aperture, drops to the ground and there pupates. The escape of the larvae occurs in Kansas from about January 1 to May. The flies emerge from their puparia in late spring and early summer to live but a short time.

jured so severely by slipping in icy pastures while stampeding under attacks by starlings they had to be destroyed.

That the injury is real is attested by the following quotations from letters received by the Department of Zoology, Kansas State College, from stock-breeders and veterinarians:

"...These birds light on the backs of cattle and cause them to stampede through the yard, the birds making a strenuous effort with their sharp beaks which cause wounds in the cattle's backs."

"I am wintering around 100 head of cattle around the barn, and see these birds light on the cattle's backs and pick, I suppose they pick the grubs out."

"...They pick for the 'worm or bug' which are in the hide of the critter, and don't stop at that but go on for 'blood and meat'. . . Several of the animals have puss [sic] welts and size of a man's cap and are draining extremely."

"They are eating holes in the backs of our cattle. What is causing them to do this?"

"...They were eating holes in his cattle, on the sides, backs and jaws. . ."

Though these quotations were taken from the letters of Kansans, the offense is by no means so localized. Through the courtesy of Prof. Myron Swenk, Department of Entomology, University of Nebraska College of Agriculture, reports have been received of similar instances within the State of Nebraska. Dr. John Mizelle, of the Oklahoma Agricultural and Mechanical College, supplied the information that a county agent at Alva, Oklahoma, and a farmer near Freedom, Oklahoma, have reported damage to cattle in those areas. Dr. George O. Hendrickson of Iowa State College has stated that there have been several reports of starlings alighting upon the backs of cattle in Iowa, even in barns, but apparently no harm was done. All of the records just considered were obtained during and immediately following a severe and protracted period of cold and snow throughout the mid-west area.

Texas cattle are also included in the starling attacks upon cattle in the midwest, as evidenced by the following sentences extracted from a letter received by Dr. E. G. Kelly from R. R. Reppert, Extension Entomologist, College Station, Texas:

"The other day in a section where we had been following out the program of cattle grub control, one of the ranchmen himself introduced the subject of starling injury by saying that the 'black birds' that were so numerous there had been seen inserting their bills into the holes made by the grubs for their full length and withdrawing the grubs. He made this statement with the evident impression that the birds were beneficial. . . he volunteered some additional information stating that an animal that recently died from some cause had been entirely consumed by the starlings before he had had opportunity to dispose of it otherwise. He took special pains to state that calves, coyotes or other animals had not thus disposed of it."

It has long been known that certain birds pick up the larvae of ox warbles as they drop to the ground to pupate (Bishopp et al., 1926). Instances of magpies (*Pica pica hudsonica* Sabine) attacking the backs of cattle, apparently for the grubs buried therein, are mentioned by Bishopp (op. cit., pg. 80). Why starlings should assume this habit is perhaps explained when one considers that the starling is a member of an old-world family of birds, among whose members are numbered at least two species of ox-peckers, rather aptly named Genus *Buphaga*. A quotation given us by Knowlton (1909) reads surprisingly like the letters quoted above. Knowlton writes:

"... The African Ox-pecker (*B. africana*), which inhabits northeastern Africa... is generally met with in small flocks... Of its habits, Mr. Ayres writes as follows: 'Luring our stay in the bush, ox-peckers appeared in numbers about our oxen, and actually ate large holes in the fleshy parts of their backs, often one or two inches deep and two or three inches in diameter, thus creating bad sores. They do this little by little and day by day, attacking just that part of the back where the ox cannot swish them off with its tail or dislodge them with its horns... I have not seen any holes picked by these birds in the buffalo or other game, but only in the cattle.'"

It thus seems possible that under the stress of severe weather conditions and restricted food, the starlings are utilizing a racial instinctive adaptability possessed by other members of its family. One may account for the lack of damage in January to the Iowa cattle mentioned above with the knowledge that the warbles appear later in the backs of northern cattle than in the backs of southern herds. If severe conditions should exist in early March in Iowa and Wisconsin, it is possible reports of starling injury will be received from these areas.

Damage to cattle by starlings is not limited to attacks upon cattle infested with warbles. A report of starlings attacking branding wounds on cattle was investigated by men from Kansas State College. Examination showed several animals with raw and infected wounds, sometimes several inches in diameter, in place of the clear-cut brands of other animals. At the time of the visit, no starlings were feeding upon the wounds. The severity of the weather had moderated, seemingly making available normal food sources. Starlings were seen, however, in the tops of trees around the farmstead. It thus seems entirely possible that starlings will, under stress of food shortage, attack open wounds on animals as well as warble infestation.

Control of Starling Attacks

There is little that can be said at the present time about the control of starling attack upon cattle. It is doubtful that the birds will become a serious pest of range animals, because the starling is

essentially a bird of urban and field habits rather than a bird of the range land. The cattle of the feed lot and pasture, the dairy herd and feeder stock, suffer most.

Rifle and shotgun fire have been used by stockmen against the birds at feed lots and stables, with a degree of success. However, the birds are soon made wary of the hunter, and confine their attack to periods when no human being is in sight. Starlings have been decimated at their roosts by the concerted action of numbers of men with shotguns, all shooting at the same time and before the birds have opportunity to fly beyond range. They may be trapped in baited traps, particularly during periods of food shortage (Kalmbach, 1937). Starlings seem quick to learn the significance of such a device and cannot apparently be trapped more than once. Starlings range so widely in their feeding movements that the inability of laying poisoned bait at a sufficient number of feeding stations makes this method of control ineffective. An English gamekeeper successfully prevented starlings from occupying a roosting site by flying a hawk-shaped kite in the vicinity of the roost (Coward, 1929). It would be interesting to note the reactions of starlings around a feed lot if a hawk kite were flown in the neighborhood.

Experiments carried out under the knowledge of Dr. E. G. Kelly and the county agent of Comanche County, Kansas, indicated that a high degree of relief from starling attack may be obtained by the manual expression of ox warbles from their tumors as soon as the size of the warble and its pit makes this procedure practicable. Dr. J. W. Lumb, Kansas State Extension Specialist in Veterinary Medicine, suggests small herds be treated three times throughout the later winter months, and that larger herds be treated at least twice. This expression not only rids the pastures of the pupating flies and a subsequent generation of warbles, but also permits the early healing of the breathing aperture and thus precludes the making of a flesh-wound or the infection of the warble tumor by attacks of the bird.

Adult warble flies live but a short time after emergence, and seem never to fly very far from the point of emergence. For this reason, successful control and elimination of warble infestation the subsequent year may be obtained by close-herding the animals from late December through March, followed by prompt removal of the livestock to a pasture at least a mile distant from the area where the larvae were dropped (Kelly, 1938). Needless to say, control of warbles is good farm practice from several points of view: it removes the parasite toxins from the blood of the host, thus strengthening the animal for the proper deposition of beef or production of milk; it makes for greater market value by avoidance of discounts for

warbly hides and by removing the necessity of trimming cuts of meat in areas occupied by warbles. Furthermore, elimination of warble infestation may solve the major cause of starling attacks upon cattle, permitting the mid-west area to benefit from the useful activities known to be performed by these birds.

Though the control of warbles would seem to eliminate one source of attack by starlings, it is to be remembered that open brands or other wounds may attract the birds during periods of extreme food shortage. Such wounds ought to be protected carefully by burlap shields, or wounded animals should be confined within tight buildings until the wounds have healed sufficiently to baffle starling attack.

Prospects in Future

Cartwright (1924), basing his statements upon an analysis of Christmas bird censuses, suggests the starlings are gradually shifting from city to country habits. Eastern ornithologists generally concede that starlings are gradually working southward in what may become a seasonal migration. Ewing (1924) states that starlings have an inherent tendency to migrate, but that this ability has been lost because of the new surroundings in the western hemisphere. He continues with the suggestion that starlings, loving the company of other birds, frequently join the flocks of grackles which assemble in the fall of the year for their migration southward, and remain with the grackles when they drift southward. It is thus possible, when the starlings have mastered the art of migration in their new homeland, that they will drift from our northern cities and thus relieve these cities of their undesirable winter population of these birds. If the great plains area is included in the area deserted by starlings upon the onset of winter, as it is deserted by grackles, then we may expect little damage to our cities and livestock on the part of the starling.

At all events, it may be assumed that the experience of stockmen during the severe weather of January, 1940, may not be soon repeated because of the number of factors which must reach their optimum at the same time to create the conditions met with this winter. There must be abundant flocks of starlings, severe cold and snow-covered ground, all at the time warbles are present in the backs of warble-infested cattle. If one or more of these factors are inoperative, no serious trouble need arise.

It would be well for interested ornithologists and stockmen to follow the suggestions of Collinge (1921), who recommends four steps leading to the better understanding and control of a bird species which may prove to be a decided pest to American agriculture. Collinge's points are: 1. systematically collect eggs from

starling nests and destroy autumn concentrations of the birds; 2. make farm buildings starling-proof; 3. maintain stringent regulations for the protection of birds of prey; 4. recheck the food habits of starlings at periodic intervals to gauge their economic importance under varying conditions. All ornithologists agree that the starling is in America to stay. By sheer force of numbers, its insect-eating habits will make it more valuable to us than the indigenous birds it is bound to supplant. There is no doubt that locally, where its fruit-eating habits of certain seasons of the year, or where its attacks upon other animals make it undesirable, it must be controlled. No doubt effective methods of control will be forthcoming as the bird and its habits are better understood in its new environment.

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THE MEDICATION OF CATTLE FOR THE CONTROL OF HORN FLIES

W. G. Bruce,

U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine

Preliminary experiments by Knippling (1938) have shown that larvae of the horn fly (*Haematobia irritans* (L.)) cannot develop in the droppings of cattle that are given orally certain quantities of phenothiazine. Other experiments along this line were conducted by the writer (1939), who by the close of 1938 had found phenothiazine to be the only material then tested which was effective. Although this chemical was effective in comparatively small doses (1 gram per hundredweight) it had certain undesirable qualities which made it unfit for general use. Experiments were therefore continued in 1939 in an effort to find a suitable chemical that would be toxic to the larvae of the horn fly but harmless to cattle.

Procedure. The experimental cattle were confined in a screened building at least 1½ days prior to their medication and given a ration of bran and prairie hay. The chemical was administered by mixing it with the bran or water or, if it was distasteful to the animal, it was placed in a capsule and given with the aid of a balling gun. A sample of the droppings collected less than 3 hours before medication was used as a check. The animal was usually medicated at 4:00 p. m. and droppings were collected at approximately 8:00 a. m. and 4:00 p. m. each day thereafter for as many days as the test was in progress. Approximately 500 grams of the droppings from each collection, infested with 50 or 100 horn fly eggs, was placed on 800 grams of moist sand in a pan. Each sample was kept in an individual screen cage in the insectary, and the emergence of flies therefrom was recorded.

Results. The general results of 68 tests with 29 chemicals are shown in table 1. It will be noted that four chemicals gave a 100% kill in the doses indicated. Three of these are considered unsuitable for practical use. Azobenzene is extremely distasteful to cattle and therefore must be administered in a capsule. This, obviously, is an expensive, time-consuming process. In one test, a steer given 4.5 grams per hundredweight of azobenzene for 2 consecutive days became sore and stiff in the legs. Smaller doses had no apparent effect on the animal, but were not so effective against the horn fly larvae.

Similarly, 2,4-dinitrophenylhydrazine was distasteful to the cattle and had to be administered in a capsule. This chemical gave a 100% kill of larvae in droppings collected 16 hours after medication but no kill in droppings collected 8 hours later.

Table 1.—Toxicity of certain chemicals to horn fly larvae.

Chemical	Total No. of tests*	Dose, Grams per Cwt.	Administered in	Effect on Host	Approximate Kill, Per cent
Azobenzene	4	4.5	Capsule	Stiff joints	100
Benzophenone	1	4.5	Capsule	None	20
Borax	2	4.0	Bran	None	20
Copper nitrate	1	1.0	Bran	None	5
Copper sulfate	1	1.0	Capsule	None	50
Copper sulfate Cube (5% ro- tenone)	2	†	Water	Solution distasteful	0
Cuprous oxide	2	1.0	Bran	None	10
Derris (9% rotenone)	1	2.8	Capsule	None	50
Derris (9% rotenone)	3	5.0	Bran	None	25
Derris (5% rotenone)	3	5.0	Bran	None	20
Dibenzyl	1	4.5	Capsule	None	60
2,4 dinitro- anisole	1	4.5	Capsule	Off feed, urine purple	10
2,4-dinitrophenyl- hydrazine	1	4.5	Capsule	None	100‡
Diphenyl	1	4.5	Capsule	None	10
Diphenyl- amine	1	1.0	Capsule	None	5
Diphenyl- guanidine	1	4.5	Capsule	Off feed, dopey	0
Diphenyl- sulfoxide	1	4.5	Capsule	Off feed, puf- fy around eyes	0
Iodoazo- benzene	1	2.0	Capsule	None	75
Methylene blue	1	4.5	Capsule	Laxative	75
Nicotine sulfate	1	§	Bran	None	40
p-Nitro- phenetole	1	4.5	Capsule	Lost weight Discolors milk and urine	10
Phenothiazine	9	1.0	Bran	None	100
Phenothioxin	1	1.0	Bran	None	20
Phenylurethan	1	4.5	Capsule	Laxative	30
Pyrethrum	2	4.0	Bran	None	0
Rotenone	16	0.3	Bran	None	100
Sulfanilamide	1	1.7	Bran	None	10
Sulfur	1	4.5	Bran	None	0
Timbo (5% rotenone)	2	1.0	Bran	None	25
Tobacco (1.8% nicotine)	4	5.0	Bran	None	30

* Includes all tests with various doses as well as the dose indicated in the next column on which the succeeding data are based.

† 1 gram per gallon of drinking water.

‡ 100 per cent kill for approximately 16 hours, none at 24 hours.

§ 2 ounces of 0.4 per cent nicotine sulfate per hundredweight.

Phenothiazine was effective in doses as small as 1 gram per hundredweight but had the undesirable quality of imparting reddish tinge to the milk of cows. Furthermore, in doses of 2.25 grams or more per hundredweight this chemical produced certain physiological disturbances as indicated by the loss of appetite, gaunt appearance, dullness of the eyes, and nervousness.

Rotenone was the most effective chemical tested. Sixteen tests with doses ranging from 0.1 to 0.5 gram per hundredweight gave consistently excellent results without noticeable harmful effect to the animal. Doses as low as 0.1 gram per hundredweight gave a remarkably high kill of horn fly larvae. Doses of 0.4 gram per hundredweight killed all horn fly larvae in the droppings for approximately 30 hours. The minimum effective dose is 0.3 gram per hundredweight administered daily during the horn fly season. In one test, in which a 640-pound steer was given 1.9 grams of rotenone (0.3 gram per hundredweight) daily for 6 days, approximately 96% of the larvae were killed in droppings voided from the sixteenth to the fortieth hour after the first dose, and no larvae developed in subsequent droppings until 40 hours after the last dose. The few flies that developed in these droppings were so small and weak that it is doubtful whether they could reproduce.

Summary.—Sixty-eight tests with 29 chemicals were made to determine their value in preventing the development of larvae of the horn fly (*Haematobia irritans* (L.)) in the droppings of cattle. The chemicals were administered by mouth, either mixed with the bran or in water or in a capsule. Rotenone was effective in much smaller doses than any other chemicals and had no apparent harmful effect on the animal. The minimum dose of rotenone that killed all horn fly larvae was 0.4 gram per hundredweight. The droppings voided during a period of approximately 30 hours, beginning less than 10 hours after administration of this dose, were rendered unfavorable for the development of horn fly larvae. The minimum effective dose is 0.3 gram per hundredweight administered daily. A few flies emerged from droppings of cattle fed this dosage, but they were so small and weak that they probably would be unable to reproduce.

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NOTES ON OKLAHOMA BOT FLIES

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The damaging effects of this group of insects have been recognized for a long time, however the bionomics and controls, continue as problems of much controversy. The purpose of this paper is to present the heretofore unpublished records of specimens present in the Entomological Museum of Oklahoma A. and M. College, and some observations made by the authors on the bionomics of one species. All information, except where noted, is from adult material identified by David Hall and S. W. Bromley, to whom the writers are indebted for the determinations.

FAMILY GASTEROPHILIDAE

Gasterophilus intestinalis (DeGeer) (*G. equi* (Clark)). Wells and Knipling (1938) found that this was not the most abundant species present in the horses dissected in Illinois and Iowa, as had been expected. It is represented in the collection by: Five specimens, Stillwater, July 21, 1930 (H. Whitaker); two specimens, Stillwater, September 23, 1933 (R. Dahms); and one specimen from each of the following localities: Stillwater, September 21, 1931 (H. Whitaker); Cushing, June 15, 1932 (W. D. Davis); and Woodward, August 13, 1932 (W. D. Davis).

Gasterophilus nasalis (Linn.) (*veterinus* (Clark)). Contrary to popular opinion, Wells and Knipling (1938) found this to be the most abundant species in the vicinity of Ames, Iowa. It is apparently rare in Oklahoma, if the records serve as an adequate index; being represented by one specimen from Stillwater, October 25, 1934 (C. A. Sooter), one from Farris, November 5, 1934 (C. E. Sanborn), and one from Tulsa, April 28, 1938 (L. Harris).

Gasterophilus inermis Brauer. This species is apparently rare in Oklahoma. There is one specimen from Stillwater, May 14, 1932 (W. D. Davis) present in the collection.

FAMILY OESTRIDAE

Hypoderma lineata (de Villers). This species has often been confused with *H. bovis* (DeGeer), the two being of much economic importance in cattle, however, the latter species is not represented in the collection. The former species is represented as follows: Stillwater, April 13, 1936 (K. C. Davis); Perkins, April 17, 1932 and Stillwater, March 16, 1932 (M. L. Costner); and Stillwater, March 23, 1932 (W. D. Davis), each collection being represented by one specimen.

FAMILY CUTEREBRIDAE

Cuterebra cuniculi (Clark). As is the case with all members of this family, this species is very rare. It has a wide distribution in the United States, and published records show that the larvae are the most common bots to be found in rabbits in the Eastern States. It is represented by one specimen collected at Stillwater, May 15, 1932 (H. Whitaker).

Cuterebra (Bogeria) buccatta (Fab.). Painter (1930) lists this as being more common than *C. cuniculi* in Kansas. This in addition to the observations by the authors would suggest that this species is more prominent in the Middle West than in the Eastern States.

For a period of one year, January 1, 1939 to January 1, 1940, periodical collections of the Cottontail Rabbit (*Sylvilagus floridanus alacer* (Bangs)), were made at Stillwater, Oklahoma, totaling 197 rabbits for the year. Each month at least 5 and no more than 32 rabbits were collected; of this number, 6 were found to be harboring warbles. Five of the nineteen animals examined in June were found to be infested with these parasites; three larvae being removed from one rabbit. The sixth parasitized rabbit was taken on November 21. The specimens taken in June were found in the scrotum, while the one collected in November, was removed from the region of the loin.

The larvae taken June 11 were placed in moist sand at ordinary room temperature, and two flies emerged on August 25, one male and one female. They were identified by the authors as *Cuterebra (Bogeria) buccatta* (Fab.). The attempt to rear the last specimen was unsuccessful. The pupation period was close to, but no more than 74 days. One adult is present in the museum taken at Stillwater, September 10, 1930 (H. Whitaker). It is rather unfortunate that no work on the biology could be done during this period, since very little is known of the group.

LITERATURE CITED

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- Wells, R. W. and Knippling, E. F. 1938. A Report on some recent studies on species of *Gastrophilus* occurring in horses in the United States. Iowa State College Jour. Sci., 12:181-203.

THE JUNIPER MIDGE, *CONTARINIA JUNIPERINA*
FELT, A PEST OF RED CEDARS¹Ralph L. Parker² and Otto E. Wenger³

INTRODUCTION

During the years from 1935 to 1939 the terminal growths of red cedar trees were injured in various localities of Kansas. This injury was first attributed to winter drought or dry freezing caused by wind and cold or freezing of immature growth. Later this injury was identified as caused by the juniper midge. (Fig. 1). The present biological and control work was begun in February, 1939. Incomplete life history studies only were made during the late winter and spring in 1939. Later in the spring, adults that were reared from larvae collected while in hibernation beneath infested red cedar trees were identified as *Contarinia juniperina*⁴, a new species of midge which attacks several varieties of red cedar. The determination was made by Dr. E. P. Felt of the Bartlett Tree Research Laboratories of Stamford, Conn.

DESCRIPTION OF STAGES IN THE LIVING STATE

Egg. The eggs are long, white and glistening and taper slightly toward one end. They are 0.133 mm. long, 0.025 mm. wide at the greatest diameter near the large end and 0.016 mm. wide at the small end.

Larva. The overwintering or mature larvae are small, bright orange, measuring 3 mm. long and 0.75 mm. in diameter. They have the characteristic chitinous organ on the ventral aspect of the prothorax known as the breast bone or sternal spatula, or anchor process.

Pupa. The puparia are about the same size as the mature larvae and are at first the same bright orange color but gradually change to a dull translucent condition.

Adult. The adult when first emerged is light orange in color but the abdomen soon becomes the same bright orange color as are the larvae. The thoracic region is dull light orange with a brownish cast and the large compound eyes make the head appear to be a brownish black in color. The wings are hyaline with delicate venation. The legs are the same color as the thoracic region and their extreme length gives the insect an awkward appearance.

¹Contribution 491 Department of Entomology.²Professor of Entomology and Associate Entomologist, Kansas Agricultural Experiment Station, Manhattan.³Graduate student.⁴Felt, E. P. 1939. A New Juniper Midge (Diptera: Cecidomyiidae). Ent. News, 50:159-160.

BIOLOGY

Hibernation

Overwintering larvae were collected in moist soil not deeper than two inches beneath varieties of red cedar trees (*Juniper virginiana* L. and *J. chinensis* L.). Soil which had a shallow layer of mulch of fallen juniper needles appeared to be more inducive to the larvae. During February, 1939 many of the larvae still remained in the twigs of the trees. They were found between the dead end and the live portion of the twig. The infestation appeared to be widespread in Manhattan and vicinity with much injury to the red cedars. A few larvae were found in the twigs as late as the middle of March, 1939.

Life History

Egg. Oviposition was first observed on May 7, 1939, during the early evening when the humidity was rather high and little or no movement of air.

Larva. No observations.

Pupa. The first pupae were found in the soil under the trees on March 23, 1939. On March 30 about 50 percent of the larvae had pupated, by April 15 no larvae could be found in the field.

Adult. The first adults were collected April 25 from red cedar trees. By April 29 they were found in large numbers on these trees. A very few midges were found on May 20.

Habits

During the oviposition period adults were observed flying about the tips of branches which had new growth and flying to other such tips and attempting to oviposit on the new growth of each tip. Many times the midges appeared to oviposit on the new growth but not all samples of such selected new growth contained eggs. The eggs are laid near the middle of the needle and on the epidermis which is facing toward the supporting branch. The oviposition is only on new, tender plant growth near the tip of the twig. (Fig. 2).

CONTROL

Chemical

Since this injurious insect lives a part of the year in the soil, various treatments of the soil would be a possible means of control during the late fall, winter or early spring. On March 30, 1939, 8 plots measuring 1 square foot were laid out on infested soil beneath infested trees. There was a $\frac{1}{4}$ inch matting of needles on one half of the plots, the other half being exposed soil. The various chemicals were applied to the soil late in the day, between 4 and 6 o'clock. The air temperature at this time was 72° F. and there was a slight

south breeze blowing.

Two treatments with a 20 percent ethylene dichloride emulsion, one with dichloroethyl ether, and one with paradichlorobenzene were applied to separate plots.

The ethylene dichloride emulsion was made according to the method of Oliver I. Snapp² of the Bureau of Entomology and Plant Quarantine. This emulsion was prepared by following the standard formula of mixing slowly and thoroughly 9 parts by volume of ethylene dichloride into 1 part by volume of potash fish-oil soap, and stirring in slowly 9 parts by volume of water. This is a 50 percent stock emulsion which can be further diluted for use. The 20 percent emulsion was made by mixing 6 parts of water with 4 parts of the 50 percent stock emulsion. In one experiment in which ethylene dichloride emulsion was used, the soil was stirred and turned over by hoeing. One pint of this emulsion was applied to each of the two square foot plots in duplicate.

The dichloroethyl ether was applied in a 20 percent agitated mixture of water at the rate of 1½ pints to the two square foot plots.

The third plot was treated with 1 ounce of paradichlorobenzene to the two square foot plots and then hoed into the top 1½ inches of soil.

A check plot of no treatment was included in the series. The top soil on each of the treated plots was well soaked to a depth of ¼ to ½ inch except the paradichlorobenzene plot.

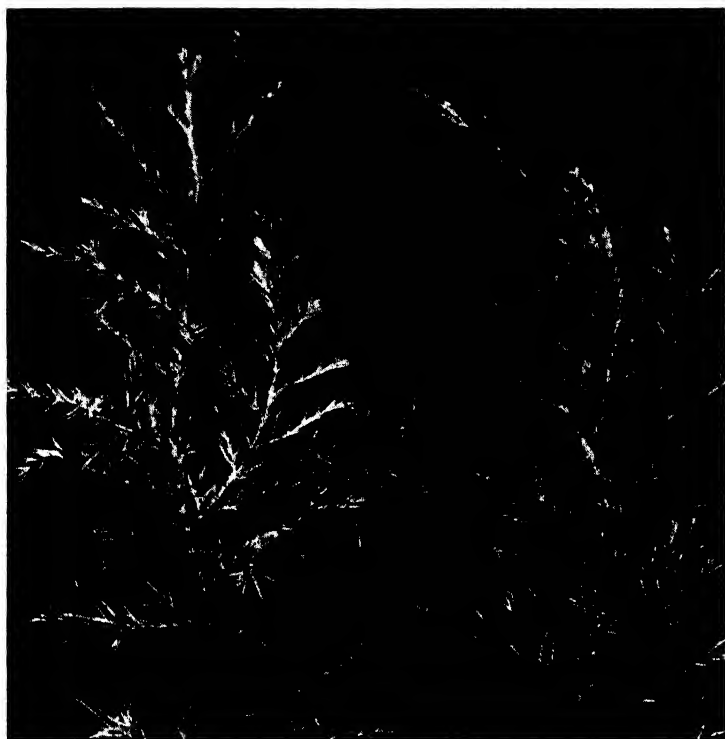
Samples of the treated infested soil from each of the plots were examined on April 7 for live and dead larvae and pupae. All larvae and pupae were dead in each sample of treated soil. After the examination counts of soil sample had been made they with the insects found were placed in rearing jars as a final determination of the insecticide effectiveness. From these samples in the jars several *Platygaster* n. sp. (undescribed) emerged but no juniper midges. Samples of infested soil from the check plot were placed in rearing jars from which midges emerged normally.

PARASITES

In the laboratory, hymenopterous parasites emerged from larvae which were collected from hibernation in the soil. The proportion of parasites to adult emerging was rather high for those which were reared in the laboratory. There were 64 midges and 177 parasites

²Snapp, Oliver I. 1938. Recent experiments with ethylene dichloride emulsion for peach borer control. Jour. Econ. Ent. 31:725.

——— 1939. Further studies with ethylene dichloride emulsion for the control of the peach borer. Jour. Econ. Ent., 32:683-685.

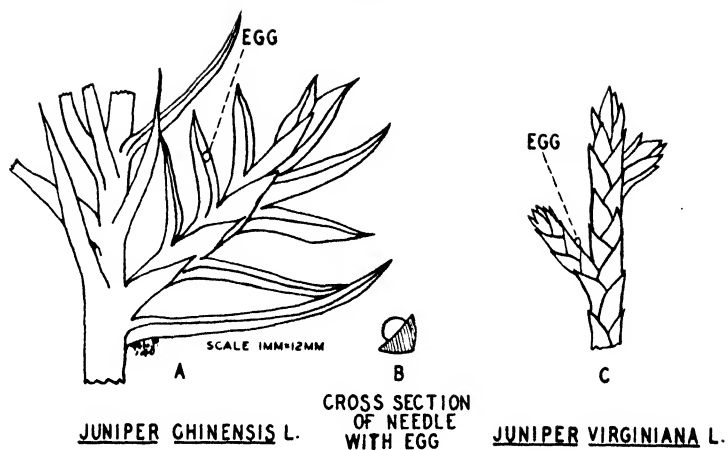


INJURED

Juniper Midge Injury

NORMAL

FIG. 1



LOCATION OF JUNIPER MIDGE EGG ON PLANT

FIG. 2

reared from this collection of specimens. The parasite *Platygaster*^a (species undescribed) was the dominating parasite. One other specimen represented a female of a species in the genus *Inostemma*^a.

Habits

In the laboratory experiment, the adult midges began to emerge rapidly at first but in a few days were replaced by an increasing number of parasites.

The hymenopterous parasite *Platygaster* (species undescribed) on April 29 and during the fore part of May was observed in large numbers flying in and out among the needles of the new tender growth of the cedars during the period of its host oviposition. It evidently was too early for larval parasitism to take place but the parasites were seeking the proper stage of its host for egg laying. It would appear that there would be an extremely high parasitism of the juniper midge by this parasite. Parasitized juniper midge pupae are easily recognized by the appearance of 1 to 3 parasite pupae within them.

SUMMARY

1. A new species of insect injurious to red cedar trees is identified to be *Contarinia juniperina* Felt, the juniper midge.

2. A description of the life stages of the insect are given.

3. The insect hibernates in the injured twigs or surface soil beneath infested trees.

4. Soil fumigants ethylene dichloride emulsion, dichloroethyl ether and paradichlorobenzene applied during the early spring to infested soil either bare or covered with needles, gave effective control of such hibernating insects.

5. An undescribed species of a hymenopterous parasite in the genus *Platygaster* appeared in great numbers from its host the juniper midge.

^aDetermination was made by Mr. C. F. W. Muesebeck, Div. Insect Identification, Bur. Ent. and P. Q., U. S. D. A. This *Platygaster* is an undescribed species near *P. pini* Fouts and *P. feltii* Fouts.

DISTRIBUTIONAL NOTES ON *COPAEODES AURANTIACA* (HEWITSON)

(Lepidoptera: Hesperiiidae)

This species has been recorded as being native only in parts of California, Arizona, New Mexico and Texas. In Kansas this species has been recorded as a visitor to Wallace and Scott counties. Indeed, only a single specimen has been taken in Scott County. Recently Dr. Turner and Mr. D. Stallings of Caldwell, Kansas have taken six or so pairs of this species in Sumner County, thus establishing the fact that it is native to Kansas.

WILLIAM D. FIELD, Lawrence, Kansas
(50)

THE GENUS COCHLORHINUS UHLER AND SOME RELATED GENERA OF LEAFHOPPERS HOMOPTERA-CICADELLIDAE

R. H. Beamer, Lawrence, Kansas*

Uhler erected the genus *Cochlorhinus* in 1876 for the single new species *pluto*. Ball in 1902 made the genus *Uhleriella* designating *Deltocephalus coquilletti* Van D. as the type. In the same paper he placed two new species, *stygica* and *signata* in this genus. In 1915 he erected the genus *Drionia* for another new black and white leafhopper, which he called *nigra*, and named two more species of *Uhleriella*, *ziczac* and *pasadena*. This group of leafhoppers presents a very interesting problem in taxonomy. They are all very closely related, as is at once evident, by their external appearance and a study of the male genitalia. They are all found in California and the black ones, at least, are usually collected upon grasses.

In this paper *Uhleriella* is submerged as a synonym of *Cochlorhinus*; *Drionia* is retained due to its very different external appearance although the internal male genitalia are very close to *Cochlorhinus*; the new genus *Calonia* is proposed for *Uhleriella signata* which has but one cross-nervure instead of two as in *Cochlorhinus*; the new name *Cochlorhinus unispinosus* is proposed for *Deltocephalus coquilletti* Van D. because Osborn and Ball made it a homonym by placing it in the genus *Thamnotettix* in 1897; and one new species, *Cochlorhinus bidentatus* is described.

Key to Genera

1. Margins of vertex parallel ----- *Drionia*
 Margins of vertex not parallel ----- 2
2. With two cross-nervures ----- *Cochlorhinus*
 With one cross-nervure ----- *Calonia*

Drionia Ball

Ball, E. D., Proc. Biol. Soc. Wash., p. 167, 1915.

Resembling *Cochlorhinus* but vertex much wider than long, margins almost parallel, vertex rounding to front, face protuberant, body short and stout. Genotype: *Drionia nigra* Ball.

Drionia nigra Ball

Drionia nigra, Ball, E. D., Proc. Biol. Soc. Wash., p. 167, 1915.

Described from two males and two females from Medford, Oregon, and in collection of E. D. Ball. There are at hand in the Snow Collection 90 specimens collected at Redding, California, June 28, 1935, 60 of which are typical. The other 30 are albinistic individuals with elytra hyaline, veins white, and only a dark spot on vertex, pro-

*Contribution from Department of Entomology, University of Kansas.

notum and scutellum remains of the usual black color.

Internal Genitalia: Pygofer about as wide as long, somewhat rolled in on apical third, with two inwardly projecting spines. Aedeagus with shaft almost straight, enlarged in lateral view at apex with two pairs of processes about half as long as shaft, arising just before apex on ventral side, and one pair of processes about as long as others on dorsal side, near outer third.

Specimens at Redding, California, were collected by sweeping the heads of a grass growing about 18-20 inches in height.

Cochlorhinus Uhler

Uhler, P. H., Bul. U.S.G.S., No. 5, p. 385, 1876.

Resembling *Drionia* in color and ventation, but vertex sharp, margins not parallel, face not tumescent. Body normal, not stout; elytra with two cross-nervures, covering abdomen; pygofer usually with two apical spines.

Genotype: *Cochlorhinus pluto* Uhler.

Key to the Species of *Cochlorhinus*

1. Only a white dash on cross-veins, remainder of dorsum black 2
At least some of other veins white 3
2. Vertex acute, longer than wide *pluto*
Vertex about a right angle *stygius*
3. White middle cross-band of pronotum distinct 4
White middle cross-band of pronotum absent, or nearly so *ziczac*
4. Male plates short, semicircular, pygofer short, with one long spine; lateral margins of last ventral segment of female not broadly rounded to posterior margin *unispinosus*
Male plates long; pygofer with two spines; lateral margin of last ventral segment of female broadly rounded to posterior margin 5
5. Vertex from eye to eye rounded, greater than a right angle, male plates with apices sharp *pasadenus*
Vertex from eye to eye sharp, about a right angle, male plates with apices rounded *bidentatus*

Cochlorhinus pluto Uhler

Cochlorhinus pluto, Uhler, P. R., Bul. U.S.G.S., No. 5, p. 358, 1876.

A long, sharp-headed leafhopper, black throughout except broad band across face, white dash on cross-veins and portions of legs white.

Genitalia: Last ventral segment of female about one-third longer than preceding, lateral angles rounded to a median notch occupying

one fourth width of segment and half as deep as wide. Male pygofer with rounded apices, with two moderately long spines extending toward opposite side; plates about as long as combined width at base, evenly tapered to fairly sharp apices; aedeagus about as long as plates, in lateral view straight, tapered slightly from base to a rounded apex, ventral margin with two pairs of basally projecting processes about as long as shaft; dorsal margin with one pair of processes arising near outer fourth and about half as long as ventral processes.

***Cochlorhinus stygicus* (Ball)**

Uhleriella stygica, Ball. E. D., Can. Ent., p. 55, 1902.

Resembling *C. pluto*, but vertex much shorter, about a right angle.

Genitalia: Last ventral segment of female about one third longer than preceding, lateral angles rounding to a median notch occupying about one third width of segment and one third as deep as its own width. Male pygofer about twice as long as wide, with two short apical spines projecting toward opposite side; plates about as long as combined basal width, roundly narrowed to fairly sharp apices; aedeagus about as long as plates, in lateral view shaft straight, slightly tapered to enlarged, rounded apex with two pairs of spines on ventral margin just before apex, reaching about one third length of shaft, and one pair on dorsal margin, reaching to about same place as ventral.

This species is very close to *C. pluto* in internal genitalia. The pygofer is a little broader at apex, the aedeagus is slightly broader in lateral view, and the processes are not so long. It may be possible that this is just the short-headed extreme of *C. Pluto*.

***Cochlorhinus ziczac* (Ball)**

Uhleriella ziczac, Ball, E. D., Proc. Biol. Soc. Wash., p. 166, 1915.

Resembling *C. unispinosus*, but with much more black coloring, sometimes a small second spine on pygofer and long plates.

Genitalia: Last ventral segment of female about twice as long as preceding, lateral margins angularly narrowed, exposing large underlying membrane, posterior margin shallowly and broadly notched. Male plates about as long as combined basal width; pygofer about one third longer than middle width, one median tooth and occasionally a second smaller tooth at apex; aedeagus in lateral view slightly bent dorsally on outer third, with a pair of lateral, occasionally bifid, processes arising just before apex and extending toward base of shaft about one third length, a dorsal, much shorter, retrorse pair of processes arise near bend in shaft.

This species seems to be about midway in coloring between *C. stygica* and *C. unispinosus*. There is also apparently considerable

variation in the number of spines on the pygofer and in whether the processes on ventral margin of aedeagus are single or bifid.

***Cochlorhinus unispinosus*, new name**

Deltocephalus coquillettei, Van Duzee, E. P., Ent. Ame., VI, p. 95, 1890.

Thamnotettix coquillettei (V. D.), Osborn and Ball, Proc. Iowa Acad. Sci., IV, p. 221, 1897.

Uhleriella coquillettei (V. D.), Ball, E. D., Can Ent., XXIV, p. 55, 1902.

This species was described by Van Duzee in 1890 in the same paper with another new species, ***Thamnotettix coquillettei***. In 1897 Osborn and Ball placed ***D. coquillettei*** in the genus ***Thamnotettix***, thus creating a homonym. According to the rule, once a homonym, always a homonym, one of these two names must be changed. Since the original, ***Thamnotettix coquillettei***, has page preference, the name ***Cochlorhinus unispinosus*** is suggested for ***Deltocephalus coquillettei*** Van Duzee.

Externally ***C. unispinosus*** is very close to ***C. pasadenus*** and ***C. ziczac*** and still closer to the new species ***C. bidentatus***. This latter species, however, has the aedeagus of ***C. unispinosus*** and the pygofer with the two spines of ***C. pluto***. ***C. unispinosus*** could not, therefore, logically be separated generically from this group of species. The males may be separated by the short, almost semicircular, plates and the females by the very narrow, angular, last ventral segment with its slightly excavated posterior margin.

Genitalia: Last ventral segment of female about one third longer than preceding, lateral margins converging, very slightly rounding to shallowly, evenly excavated, posterior margin, which is about half as wide as basal margin. Male plates broadly rounded, together forming about a semicircle; pygofer much shorter than plates, much wider than long, with long, slender spine on inner angle next anal tube; aedeagus in lateral view with shaft curved near middle, apex enlarged, rounded with a pair of retrorse, bifid processes arising before apex, and a pair of simple, shorter processes on dorsal margin.

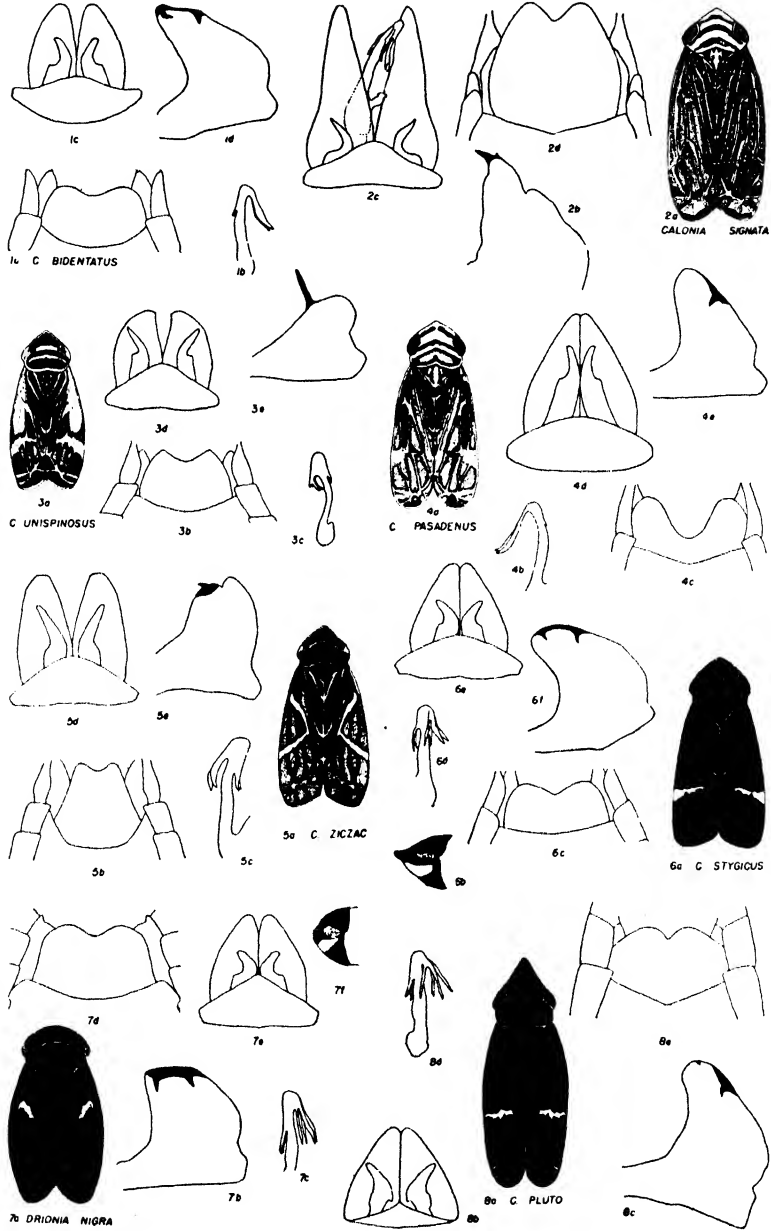
Neoholotype male and neoallotype female, California, Coquillett, a pair of Van Duzee's cotypes in the Iowa State College Collection, Ames, Iowa, are here designated.

***Cochlorhinus pasadenus* (Ball)**

Uhleriella pasadena, Ball, E. D., Proc. Biol. Soc. Wash., XXVIII, p. 166, 1915.

Resembling ***C. unispinosus*** externally and ***C. stygica*** in genitalia. From the former it may be separated by the broader, more rounded, vertex, and from the latter by the many white markings.

Genitalia: Last ventral segment of female slightly longer than



preceding, margins straight, rounding to posterior margin, which is evenly excavated half way to base. Male plates long and pointed longer than their combined basal width; pygofer about twice as long as median width with one large spine on ventral margin one third distance from apex, aedeagus in lateral view slightly curved throughout its length, sides almost parallel, with a pair of retrorse, dorsal processes at tip more than half as long as shaft, widest on their outer third, ventral processes reduced to a pair of small teeth; styles much longer than in other species, reaching beyond outer third of plates.

***Cochlorhinus bidentatus*, n. sp.**

Resembling *C. unispinosus*, but males with longer, more pointed plates and females with lateral margin of last ventral segment rounded to the posterior margin instead of angled. Length 4.25-5 mm.

Shape of vertex about a right angle, wings about as in *C. unispinosus*.

Color markings about as in that species, with the exception that the anterior white cross-band on pronotum reaches margin while in *C. unispinosus* it is usually surrounded by the black bands.

Genitalia: Last ventral segment of the female about one third longer than preceding, lateral margins broadly excavated its entire length, rounding to posterior margin, which is broadly and shallowly excavated. Male plates about as long as combined basal width, fairly sharp pointed; pygofer about twice as long as median width, apex sharp with two spines, one at tip and one before; aedeagus in lateral view slightly curved, widest at base, with a pair of retrorse processes at tip on ventral margin more than half as long as shaft, a pair of retrorse, dorsal processes reduced to very short teeth.

Holotype male, allotype female, and three male and 24 female paratypes, above Mint Canyon, California, June 7, 1935. Other paratypes as follows: 5 females and 1 male, Saugus, California, June 7, 1935; 1 male and 2 females, Cajon Pass, California, June 6, 1935; all collected by P. W. Oman.

Types and paratypes in U. S. National Museum, paratypes in Snow Entomological Collection.

***Calonia*, new genus**

Resembling the light-colored species of *Cochlorhinus*, but with one cross-nervure instead of two in the elytra.

Genotype: *Calonia signata* (Ball)

***Calonia signata* (Ball)**

Uhleriella signata, Ball, E. D., Can. Ent. XXXIV. p. 56, 1902.

Easily separated from the other black and white species by having but one cross-nervure, by the long sharp plates of the male,

and the very long, last ventral segment of the female.

Dr. Ball's original description very clearly portrays this species.

Genitalia: Male plates long and sharply triangular; pygofer extending beyond plates, but when open on a slide is almost as wide as long, roughly bilobed with inner lobe narrow and ending in a double spine; aedeagus in lateral view slightly bent dorsally on outer third, with a pair of retrorse processes on other margins about one third as long as shaft, ventral pair arising slightly nearer apex than dorsal.

Numerous specimens at hand swept from a wild, plum-like shrub in Mint Canyon, California, July 6, 1933.



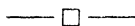
A DISTRIBUTION NOTE ON *GRAIS STIGMATICUS* (MABILLE)

(Lepidoptera: Hesperidae)

This species is found from southern Brazil north through Mexico. In the United States it has been recorded as probably being native around Kerrville, Texas where numerous specimens have been taken during the month of September. The writer has taken it also at Ft. Stockton, Texas on July 11, 1936. Calkins' states that three or four specimens of this species have been taken late in the summer in Scott County, Kansas. All of his species were taken after dust storms or strong southern winds. This species can be regarded as native to southern Texas but only a visitor to Kansas.

¹V. F. Calkins, "The Rhopaloceros Lepidoptera of Scott County, Kansas," Ent. News, vol. XLIII, p. 259, Dec., 1932.

WILLIAM D. FIELD, Lawrence, Kansas



A NEW SKIPPER RECORD FOR THE UNITED STATES

(Lepidoptera: Hesperidae)

A single specimen of *Thymeles fulgerator* Walsh was taken at Donna in Hidalgo County, Texas by Miss Calla Stainke on November 10, 1935. It is entirely unlikely that this species is anything other than one of the numerous visitors that cross our border from Mexico from time to time. *T. fulgerator* is common in various parts of Mexico and is found from there south to Columbia and Brazil. The genus *Thymele* F. is a rather large tropical genus containing something like thirty-two species. This is the first record of any member of the genus being found as far north as the United States. Dr. A. W. Lindsey of Granville, Ohio has checked my determination of the specimen.

WILLIAM D. FIELD, Lawrence, Kansas

NEW MID-WESTERN DOLICHOPODIDAE
(Diptera)¹F. C. Harmston and G. F. Knowlton²

The following report consists of descriptions and figures of two apparently undescribed long-legged flies from Illinois and one from North Dakota³.

Argyra similis n. sp.

Male. Length, 4 mm.; of wing, 3.3 mm. Face narrow, densely silvery pollinose; palpi yellow, whitish pollinose, their surface with long pale hairs near tip; front concolorous with face, its pollen dense; antennae (fig. 2) black, first joint short, glabrous, joint III longer than combined length of joints I and II; arista inserted near the tip of third joint, longer than antenna, slightly pubescent; lower orbital cilia and whiskers white, upper cilia black, delicate.

Dorsum of thorax and the scutellum greenish metallic, the reflections somewhat coppery, surface of both dulled with white pollen; pleurae darker, its ground color hardly perceptible through the dense whitish pollen; abdomen with first segment black, dulled with white pollen, the whitish hairs on lateral margin long, delicate; second and third segments wholly yellow except narrowly along dorsal incisures; fourth, fifth and sixth segments black, their upper surfaces densely pubescent, entirely hiding the ground color; hairs and bristles of abdomen yellowish, yet the larger bristles along the incisures appearing brownish in certain lights; hypopygium (fig. 9) black, rounded behind, the outer lamella yellow, slender, fringed with yellowish hairs; inner lamella wholly yellow. Halteres dark yellow; calypters yellow with narrow brown tip, their cilia yellow.

All coxae, their hairs and bristles yellow; femora, tibiae and tarsi yellow; fore and middle femora with delicate whitish hairs on lower and posterior edges; posterior femora with delicate whitish hairs on lower edge, especially near the base; joints of fore tarsi as 15-6-5-3-3; of middle tarsi as 15-5-5-3-2; of hind tarsi as 10-10-8-4-3.

Wings (fig. 4) grayish hyaline, broad, especially near base; veins brownish yellow.

Described from one male taken at Dongola, Illinois, May 11, 1917. Type in the Illinois Natural History Laboratory.

Taxonomy. This species is closely related to *Argyra* (*Leucostola*)

¹Contribution from the Department of Entomology, Utah Agricultural Experiment Station.

²Research assistant and research associate professor, respectively.

³Species here described were present in material from the Illinois Natural History Survey and University of Utah insect collections received for identification.

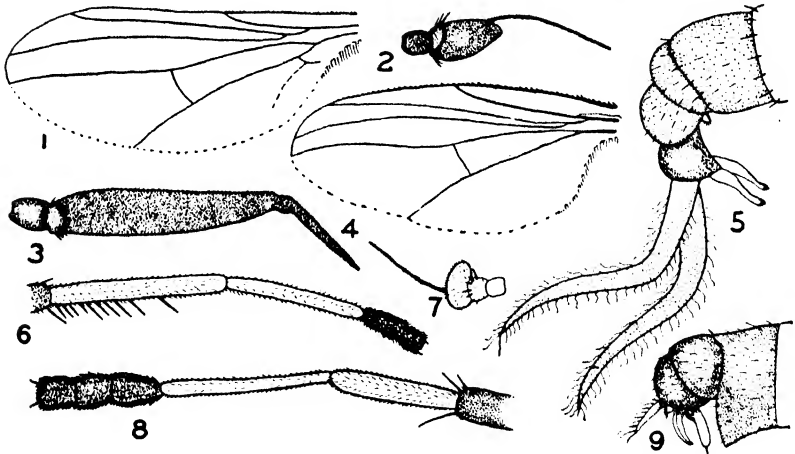
johnsoni Van Duzee. In *johnsoni* the cilia of the inferior orbit are yellow whereas in *similis* n. sp. the orbital cilia are white; the wings of *johnsoni* are tinged with brown in front of the fourth vein but are entirely grayish hyaline in *similis*; *johnsoni* has the second joint of middle tarsi more than one-half the length of first joint, whereas the first joint of the middle tarsi in *similis* is three times the length of the second joint. Both *similis* and *johnsoni* resemble *cingulata* Loew, but in the latter species the abdomen is wholly without pollen.

Chrysotus chlanoflava n. sp

Male. Length, 2 mm.; of wing, 1.7 mm. Face narrow, the eyes barely separated below; lightly dusted with yellowish brown pollen, barely allowing the green ground color to show through; front metallic green, its central portion dull bronze, appearing rough, but without pollen; palpi small, white, a few delicate blackish hairs near the tip; antennae (fig. 7) yellow, the third joint pubescent, short, broad, obliquely rounded anteriorly; arista apical, slightly longer than antenna; orbital cilia, including uppermost, white.

Thorax metallic green, lightly dusted with white pollen, the dorsum with bronze reflections; pleurae with the pollen more dense; abdomen metallic green with bronze reflections; bristles of thorax black, those of abdomen yellowish, yet the latter appearing brown in certain lights; hypopygium small, black, its appendages partly imbedded, consisting of a pair of small yellowish outer lammellae which are densely ciliated, and a slender, posteriorly projecting organ.

Fore coxae yellow, their anterior surface with white hairs; middle and hind coxae concolorous with pleurae, their tips narrowly yellow;



Rhaphium rossi n. sp. Male, 1, 3, 5-6, 8. *Argyra similis* n. sp. Male, 2, 4, 9. *Chrysotus chlanoflava* n. sp. Male, 7.

femora and tibiae yellow; fore tibiae without bristles; middle tibiae with three black bristles on outer posterior side, two on basal half, the other at tip; hind tibiae with three pairs of bristles, and a narrow glabrous line separating their bases; all tarsi of plain structure, the fore and middle pairs yellow, infuscated only at the extreme tip; hind tarsi slightly infuscated from the tip of first joint; halteres, calypters and their cilia pale yellow.

Wings grayish hyaline; cross-vein situated before the middle of wing.

Female. Length. 2.6 mm. Face wider than in male, its pollen gray; pulpi broad, infuscated at base, the bristles near margin stronger than in male; third joint of antennae brownish; legs as in male except that fore coxae and tarsi are somewhat more infuscated.

Described from 3 males and 2 females taken at Tower City, North Dakota, June 23, 1906 (M.W.R.).

Holotype and allotype in the University of Utah collection; paratypes in the Utah Agricultural Experiment Station and the U. S. National Museum insect collection. **Taxonomy.** *Chrysotus chlanofflava* n. sp. traces to the first part of couplet 69 of the Van Duzee key (Buffalo Soc. Nat. Sci. Bul. 13:10, 1924) differing, however, in the palpi being short.

Rhaphium rossi* n. sp.

Male. Length, 4.6 mm.; of wing, 3.8 mm. Face short, leaving the lower fifth of the eyes sharply exposed, moderately wide, silvery pollinose; front metallic blue-green, pollinose only near the base of antennae; palpi black, their apical margin fringed with white, flattened hairs, which are nearly as long as the palpi; antennae (fig. 3) black, the third joint nearly twice the length of face; arista slightly more than one third the length of third joint, thick at base, gradually tapering, densely pubescent; lower orbital cilia and whiskers white, about six of the upper cilia black.

Dorsum of thorax and the scutellum metallic blue-green, lightly dusted with whitish pollen; pleurae concolorous with dorsum, less shining, its ground color almost completely hidden by whitish pollen; abdomen metallic, the anterior half of each segment black, the posterior half blue; lower posterior half of the lateral margin of the first five segments densely whitish pollinose; hairs of the abdomen black except those on the sides which are white, delicate; hypopygium (fig. 5) black; outer lamellae long, tapering, brownish, ribbon-like, fringed with delicate yellowish cilia; inner lamellae slender, finger-like, largest at base and slightly enlarged at tip.

Fore coxae wholly yellow, their anterior surfaces with long,

*Named in honor of Dr. H. H. Ross of Illinois Natural History Survey.

dense, white hairs; middle and hind coxae blackened, their tips yellowish; middle coxae with white hairs on their anterior surfaces and with two long, black bristles, lying close together which arise near the apical fourth, without spine at tip; hind coxae with a few delicate white hairs near base and a single, small whitish bristle near the middle on outer side; femora yellow, tips of posterior pair darkened at tip above; fore femora with long, delicate, white hairs on outer surface; tibiae yellow, tips of middle and hind pairs narrowly blackened; hind tibiae noticeably thickened and having a narrow, glabrous stripe on their posterior surface; tarsi with first two joints yellowish, the remaining joints black; fore tarsi plain, the fifth joint slightly widened; middle tarsi (fig. 6) with first and second joints long, the former spinulose below, last three joints short, fringed laterally forming a brush-like tip, hind tarsi (fig. 8) with first two joints nearly white, second joint nearly one and one-half times the length of first joint, last three joints black, fringed laterally, forming a conspicuous, somewhat brush-like tip; joints of fore tarsi as 10-6-3-2-5; of middle tarsi as 20-15-3-3-3; of hind tarsi as 14-20-5-4-4; halteres, calypters and their cilia pale yellow.

Wings (fig. 1) grayish hyaline, lightly tinged with brown in front of third vein.

Female. Like the male except that the third antennal joint is narrower, tarsi are plain and the wings are longer and narrower. The face of female is much wider than in the male and of darker color, the palpi are broader and lack the dense marginal fringe of flattened, white bristles, so conspicuous in the male.

Described from 15 males and 8 females, taken at Golconda, Illinois. April 18, 1914. Holotype, allotype and several paratypes at the Illinois Natural History Laboratory; paratypes in the Utah Agricultural Experiment Station insect collection.

Taxonomy. The male of *Rhaphium rossi* n. sp. traces to couplet 45 of the Curran key (Roy. Can. Inst. Trans. 15:256) where it would form a third alternative, "palpi small, black, fringed along margin with white, flattened hairs." The female traces to *lugubre* Loew, in the key to females, page 257, differing from that species in the color of hind femora and tibiae, which are black in *lugubre*, yellow in *rossi*.

A NEW SPECIES OF THYREOCORINAE

R. I. Sailer, Lawrence, Kansas*

Galgupha loboprostethia sp. nov.

General Characteristics: Body broad, slightly obovate, shining black. Antennae, tarsi and rostrum testaceous. Last segment of antennae darkest. Body distinctly punctate except on disc of both the pronotum and scutellum where the punctations are obsolete. Punctures deepest and most evident in pronotum behind anterior angles.

Head not produced more than length of eye beyond transocular line. Front margin more or less truncate. The tylus usually produced slightly. Lateral margins thickened and perceptibly reflexed near apex causing apex of disc to be somewhat concave. Lobes in front of eyes distinctly punctured. Posterior marginal area of disc impunctate. Few punctures on tylus.

Prostethium decidedly concave beneath eye and with the anterior margin produced to form an explanate lobe usually covering a portion of the base of the first antennal segment. The ventral anterior and ventral margins very finely striate.

Sternites coarsely punctate laterally with scattered obsolete punctures on median strip. Sixth sternite broadly rounded anteriorly in both male and female. Sixth sternites in male less than length of three preceding sternites together.

Hypopygium of male very lightly punctate and slightly transversely channelled. Its width between lateral angles usually less than length of sixth sternite. Length is to the width as :60 is to 7:00. The hind margin reflexed and noticeably concave medially. A conspicuous tuft of hair evident in this concavity. Dorsal rim broad and flat all around and not deeply excavated interiorly.

Sixth sternite of female scarcely equal in length to the preceding two sternites together. Genital plates punctate, about half as long as sixth sternite and about equal to postventer. Inner margin two-thirds as long as posterior and the latter slightly concave.

Length, 3.70-5.20 mm.

Comparative notes: Most closely related to *G. ovalis* Hussy, and in McAtee and Malloch's monograph of the Thyrocoryninae keys out of this species. This species differs from *G. ovalis* in a number of characters as follows: Average size somewhat smaller. The punctation of the body is more evident, particularly on the head. The apex of the head disc always perceptibly concave on each side of tylus. This is invariably flat in *G. ovalis*. The tuft of hair in the concavity

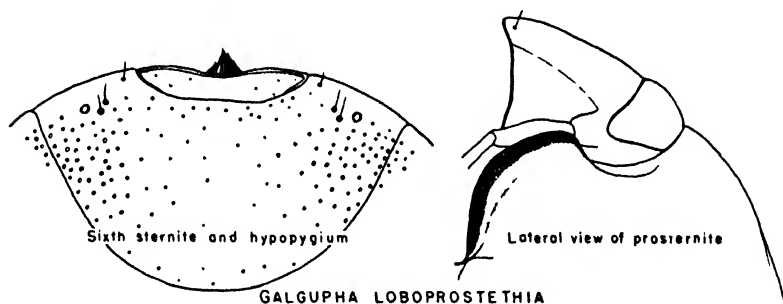
*Contribution from Department of Entomology, University of Kansas.

of the hind margin of hypopygium is absent in *G. ovalis*, and the length of the hypopygium in relation to its width is noticeably less. The most important feature of difference is the shape and the striate character of the margin of the prostethium.

This, to the extent of my knowledge, differs from all species of Thyrecorinae recorded from the U. S. with the possible exception of *G. hesperia* McA. and M. described from Calif. Specimens of the herein described species have been compared with *G. hesperia* by H. G. Barber of the U. S. National Museum.

Distributional data: Douglas Co., Kans.; Medora, Kans.; Johnson Co, Kans.; Chautauqua Co., Kans; Neosho Co., Kans; Bourbon Co., Kans.; Reno Co., Kans.; Garnett, Kans.; Yates Center, Kans., Scott Co., Mo.; Atherton, Mo.; Green Co., Mo.; Howard Co., Ark.; Woodward, Okla.; Wasta, S. D.

Types: Holotype, male, Douglas Co., Kans.; Allotype, female, Douglas Co., Kans.; 36 paratypes in the Francis Huntington Snow collection of the University of Kansas. 26 paratypes in the U. S. National Museum Collection.



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CONTENTS OF THIS NUMBER

Starling Attacks Upon Warble Infested Cattle in the Great Plains Area. Arthur L. Goodrich, Jr.	83
The Medication of Cattle for the Control of Horn Flies. W. G. Bruce	41
Notes on Oklahoma Bot Flies. Gaines W. Eddy and Kary C. Emerson	44
The Juniper Midge, <i>Contarinia Juniperina</i> Felt, A Pest of Red Cedars. Ralph L. Parker and Otto E. Wenger	46
Distributional Notes on <i>Copaeodes Aurantiaca</i> (Hewitson). William D. Field	50
The Genus <i>Cochlorhinus</i> Uhler and Some Related Genera of Leafhoppers Homoptera-Cicadellidae. R. H. Beamer..	51
A Distribution Note on <i>Grais Stigmaticus</i> (Mabille). William D. Field	57
A New Skipper Record for the United States. William D. Field	57
New Mid-Western <i>Dolichopodidae</i> (Diptera). F. C. Harmston and G. F. Knowlton	58
A New Species of <i>Thyreocorinae</i> . R. I. Sailer	62

JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY



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Kansas Entomological Society

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JULY, 1940

NO. 3

THE NINTH ANNUAL INSECT POPULATION SUMMARY OF KANSAS—1939¹

Roger C. Smith² and E. G. Kelly³

Kansas Agricultural Experiment Station, Manhattan, Kansas*

This ninth annual summary utilized the same sources of information as were used in preparing the previous summary except that the questionnaires were not sent to the county agents in October because they had been called upon too frequently for information of various kinds during preceding months. The method of summarizing the data and preparing this report for publication differs in no respect from the previous one⁴.

Table I records the totals of questionnaire reports which were used in preparing Table II of this summary.

TABLE I

Questionnaires returned and summarized for the report.

	No. in July	No. in October
Group 1. Entomologists in the state -----	17	14
Group 2. County Agr. Agents -----	94	1
Group 3. Farmers, mostly college graduates-----	16	7
Group 4. Vocational Agr. Teachers -----	30	74
Total reports -----	157	96
Grand total of all questionnaires summarized for this report -----		253

*Contribution No. 493 of the Department of Entomology.

¹This report includes results obtained in work on Project No. 6 of the Agricultural Experiment Station. Recognition for assistance in supplying information is due the same sources given in previous summaries.

²Professor of Entomology, Kansas State College, and Associate Entomologist of the Agricultural Experiment Station.

³Professor of Entomology, Division of College Extension.

⁴References to the previous summaries are as follows:

1931: Jour. Kans. Ent. Soc. 5(3): 65-92. 1 pl. 1932.

1932: do. 6(2): 37-60 1 Pl. 1933.

1933: do. 7(2): 37-51. 1934.

1934: Trans. Kans. Acad. Sci. 38:171-85. 1935.

1935: do. 39:129-149. 1936.

1936: Jour. Kans. Ent. Soc. 10(4): 113-32. 1937.

1937: do. 11(2):54-176. 1938.

1938: Trans. Kans. Acad. Sci. 42:303-323. 1939.

SUMMARY OF WEATHER CONDITIONS IN KANSAS DURING
1939^a

January had exceptionally mild weather in temperature and a good supply of moisture fell in the southern half of the state including 4 to 9 inches of snow in the eastern part of the area. There was a pronounced deficiency of moisture over the northwest quarter of the state.

February was a month of heavy snows over the state and good rains in southeast Kansas. It was a cold month but was more sunshiny than usual. Ten to 15 inches of snow fell over the northern two-thirds of the state and 4 to 10 inches in the southern third. Soil moisture was seriously deficient.

March had generous and well distributed moisture falls with mild temperatures after the first few days. Snow and rain were most plentiful in the western third of the state. It was the wettest March in 8 years while the temperature and sunshine were near normal.

April was deficient in rain fall and the temperatures for the first three weeks were abnormally low. Severe freezes early in April caused a cold late spring. Warm, drying winds the last week were unfavorable to crops.

May was the third warmest on record being 4.6° above normal, and in most sections one of the driest. More rain than needed fell in southeast Kansas. Wheat deteriorated in many parts of western Kansas especially in southwestern counties.

June was the wettest in 4 years. The temperatures were slightly above normal but withal it was a comfortable month of good growing weather. Wheat harvest in many southern counties was hindered by rains and muddy fields.

July was the fifth warmest and seventh driest experienced in the state since 1887. Excessively high temperatures, the almost complete lack of rain, the bright sunshine and drying winds made this a most uncomfortable and unfavorable month. Practically all crops deteriorated.

August was another hot, exceedingly dry month though considerably more rain fell than in July. The rains came largely in local showers which the hot, dry winds soon dissipated. Crops in the eastern two-thirds of the state improved some early in the month but they deteriorated generally near the close.

September broke all records in the history of the state for a combination of heat, drouth and unfavorable crop growing weather. There was almost no rain and dust storms occurred frequently in southwestern Kansas. Pastures declined, sorghums failed to fill properly in many places and wheat sowing over the western half of the state was largely delayed.

^aSummarized from Flora, S. D. Climatological Data, Kansas Section. U. S. Dept. Agr. Weather Bur. 53. 1939.

TABLE II
Summary of weather data for Kansas for the insect year Sept. 1938 to Dec. 31, 1939.

Temperatures: degrees Fahrenheit						Precipitation, in inches					
Month	State Average	Max-imum	Min-imum	Average for 52 years.	Departure from normal	State average	Average for 52 years	Departure from normal	East-ern third	Middle third	West-ern third
September 1938	72.3	103	31	69.7	+2.6	2.19	2.82	-0.63	2.24	1.88	2.45
October	64.8	100	11	57.1	+7.7	0.33	1.92	-1.58	0.49	0.15	0.35
November	42.6	83	-2	43.2	-0.6	1.40	1.28	+0.12	2.45	1.57	0.17
December	36.2	78	-10	33.0	+3.2	0.20	0.84	-0.64	0.31	0.11	0.17
January 1939	38.3	76	-1	29.9	+8.4	0.78	0.67	+0.11	0.99	0.73	0.63
February	30.4	70	-18	33.0	-2.6	1.22	1.00	+0.22	1.38	1.25	1.03
March	45.5	88	-6	43.4	+2.1	1.72	1.44	+0.28	1.99	1.53	1.63
April	54.5	98	13	54.7	-0.2	1.96	2.52	-0.56	3.17	1.59	1.13
May	68.5	108	32	63.9	+4.6	2.35	3.83	-1.48	3.45	1.95	1.66
June	75.3	110	40	73.8	+1.5	4.59	3.99	+0.60	5.64	5.52	2.60
July	83.4	116	55	79.1	+4.3	1.40	3.16	-1.76	1.31	1.49	1.39
August	78.1	112	45	77.9	+0.2	3.50	3.10	+0.40	4.59	4.57	1.35
September	75.5	113	24	69.8	+5.7	0.32	2.77	-2.45	0.50	0.27	0.19
October	61.1	101	18	57.2	+3.9	0.60	1.90	-1.30	1.05	0.64	0.10
November	44.3	80	4	43.2	+1.1	0.83	1.27	-0.44	1.68	0.66	0.14
December	39.0	86	-13	33.1	+5.9	0.81	0.84	-0.03	0.79	0.71	0.94
Average of totals for 1939		113	-13	54.9	2.90	20.08	26.49	-6.41	26.54	20.91	12.80

October was the fourth driest October known in Kansas which, with September, was the driest two months period ever recorded in the state. The drouth in the western third was particularly severe, there being only about one-third normal precipitation. Temperatures were well above normal though freezing weather arrived in the last four days. Some wheat was drilled in dust in western counties.

November was mild and sunshiny but unusually dry. Conditions were unfavorable to wheat especially in the western half of the state. Rainfall was below normal in almost every county. This month ended the driest three months ever recorded for this time of year, there being less than 30 percent normal precipitation. Temperatures were slightly above normal and remarkably uniform.

December had three weeks of unusually mild weather but during the last ten days, colder weather with snow and near zero temperatures prevailed. Rains on the twenty-third and twenty-fourth relieved the fall drouth somewhat. Wheat was in poor condition over most of the state.

The year as a whole was the third mildest and fifth driest in 53 years. Soil moisture was markedly deficient except for May and June. Rains during these months contributed to a cool late spring.

"Total 1939 production of major crops in Kansas was quite low compared with 1938 and with the average" being 23 percent below 1938 and only 71 percent of the 1927-36 average. This was a result of the lower crop acreage harvested and generally lower yields per acre. The 1939 wheat crop of 111,657,000 bushels compares with 152,-184,000 for 1938 while 37,330,000 bushels of corn in 1939 compares with 45,200,000 for 1938 the crop being almost wholly in the eastern part of the state. Alfalfa and other hay totaled 994,000 tons in 1939 against 1,171,000 tons in 1938. Potatoes yielded 2,128,000 bushels in 1939 against 3,219,000 in 1938. The barley crop of 7,480,000 bushels in 1939 was larger than the crop of 6,681,000 bushels of 1938 but there were nearly twice as many acres harvested in 1939—680,000 acres against 395,000. Likewise the flax, apple, peach and alfalfa seed crops in Kansas exceeded the 1938 production somewhat. The total value of all crops was estimated at \$133,606,000 in 1939 against \$145,241,000 in 1938.

⁶Logan, K. E. and Gilbert, Samuel J. Kansas 1939 Crop Review. Kans. State Bd. of Agr. Div. of Statistics, Dec. 21, 1939. (Mimeographed).

TABLE III. Population summary from the 253 questionnaires returned in July and October from all the counties in the state except Ellsworth, Hodgman, Morton, Russell and Sherman. Key: 0-The species is practically absent; 1-scarce; 2-common but not injurious; 3-plentiful and some damage was done; 4-abundant, serious injury to some fields in many communities; 5-outbreak or as plentiful as a common species has been in years of larger populations.

DESCRIPTIVE ACCOUNT OF THE MORE STRIKING INSECT
ACTIVITIES AND CLIMATIC RELATIONSHIPS FOR 1939.

Ailanthus web warms were more plentiful than usual during August and September in 1939. Practically every ailanthus tree had one or more webs in it with noticeable to severe foliage injury.

Alfalfa caterpillars attained normal numbers during 1939. Slight injury was done by this species to some irrigated alfalfa at Halstead and Garden City.

Anomea laticlavia Forst. a chrysomelid beetle was reported causing injury to fruit tree foliage in Labette and Chautauqua counties during June. It had been reported from Leavenworth County during July 1938.

Ants in houses were less numerous in the state than in 1938. They were reported chiefly from the eastern three tiers of counties and the two tiers south of Phillips and Smith Counties.

The **yellow ant** swarmed into basements of Riley County during March and April in usual numbers. Specimens were seen in March from Brown and Gray Counties.

The **Kafir ant** was reported from Jackson County attacking planted kafir seed in early June.

Aphids appeared in several fairly well defined outbreaks during 1939 and in general were probably slightly more abundant than in 1938.

The **boxelder aphid** curled the leaves of boxelder trees in eastern Kansas severely during May. There was much honey dew produced which attracted flies noticeably.

Aphids on cabbage, radish, turnips, cucumbers and melons were extremely plentiful and destructive in eastern Kansas during May. Plants not dusted repeatedly were killed or severely dwarfed by them. They were observed abundant and destructive on cucumbers in Norton, Washington, Marshall, Smith, Haskell, Ellis, Phillips, Rooks, Sheridan, Mitchell and Butler Counties and on melons in Stanton, Dickinson, Edwards, Ellis, Phillips, Smith, Kiowa and Riley Counties.

The **cottonwood petiole gall aphid** was more numerous in Kansas during June and July than for some years. Specimens were seen from Jewell County and also many galls from Riley County. The galls were exceptionally large and full of aphids. Some appeared to have been opened by wood peckers. Many leaves appeared to have been artificially severed and fell to the ground.

Elm leaf aphids (*Myzocallis ulmifoliae*) occurred in an unusually late outbreak throughout the state wherever there were elm trees during August to October. The blackish areas of honey dew under elms on pavement, sidewalks and the spots on cars were common over most of the state during the autumn. Honey dew continued to drop from the shiny leaves after the aphids were gone or up to about

September 20 when the leaves dropped.

The green bug (*Toxoptera graminum*) occurred in one of the severest outbreaks since 1916. Dr. R. H. Painter summarized the outbreak as follows:

"In 1939 green bugs spread from Oklahoma and Southern Kansas, where they overwintered in barley and volunteer small grain, across the state doing damage late in the season to fields of wheat thru the central third of Kansas. Hymenopterous parasites were not seen nor reared from green bug infested wheat around Manhattan, but lady beetles were abundant. The aphid was first reported plentiful on April 14 on barley in southern Kansas. Feeding of the green bugs during May and June was principally inside the upper leaf sheath about the developing head of wheat. In many spots in fields and occasionally whole fields of wheat, the plants were one-half to one-third normal height, the heads poorly exerted, fusiform in shape and often with less than one-half the normal amount of grain which was partly shriveled. In a few spots, plants were killed before they were half grown. Damage was widespread in the central and western parts of the state but was complicated by the presence in some areas by drouth, dry land foot rots, brown mites and red spiders. Plants showing about medium injury from river bottom fields near Wakefield where green bugs were the primary agent of injury showed an average loss of 2.3 pounds per bushel test weight and 50 percent in yield."

Injury to barley, wheat or oats was observed in Sumner, Sedgwick, Harvey, Butler, Reno, Rice, Edwards, Montgomery, Chautauqua, Cowley, Smith, Ellsworth, Barton, McPherson, Marion, Dickinson, Geary and Riley Counties. Spots of apparently damaged wheat were readily observed up to June from the highways in the counties mentioned. It is regarded as somewhat unusual for these aphids to be on the wheat heads since they are ordinarily gone by the time of heading.

The pea aphid occurred in almost destructive numbers in the eastern half of the state and in the Arkansas River Valley in the west. Severe injury to some fields was reported from Finney, Montgomery, Wyandotte, Marion, Harvey, McPherson, Atchison, Jefferson, Douglas and Johnson Counties only. Large populations with less injury occurred in Commanche, Barber, Chautauqua, Cowley, Sumner, Riley, Dickinson, Geary, Reno, Rice, Elk, and Butler Counties. Pea aphids were first seen about April 10 but they were scarce. April 15, Prof. D. A. Wilbur observed severe damage to small areas in some fields of alfalfa near Garden City. Lady beetle and Chrysopid larvae and adults were numerous everywhere but the weather was too dry before June for the fungus disease. Typically damaged small areas of alfalfa in fields were seen the middle of May in the

general area around McPherson County presumably caused by pea aphids. Ample rains beginning May 20 and extending through June enabled the plants to recover. There was loss in hay of the first cutting but the loss of stands was small. These aphids continued plentiful during the first half of June when natural enemies and fungus reduced them to usual numbers.

Some farmers used a sheet of galvanized corrugated roofing as a drag to catch the aphids. One farmer reported catching 13 tubs full in this way from 10 acres of alfalfa.

The **apple leaf skeletonizer** (*Psorosina hammondi* (Riley)) defoliated apple trees in Northeastern Kansas during early July. They appeared first, according to Dr. R. L. Parker, in the tops of poorly sprayed apple trees and most of the leaf loss occurred in the tree tops. It has been many years since an outbreak occurred but the species appeared to be increasing.

Blister beetles declined somewhat in numbers from 1938 but were still plentiful over the entire state. They were most numerous in central and western Kansas in alfalfa fields and gardens, the latter being ruined in many counties during July and August. Many beet, carrots and even Chinese elms in Gove, Meade, Finney and Rush Counties were largely defoliated. Some beetles emerged as early as May 31. They occurred in great numbers in small scattered spots of alfalfa near Garden City in July and destroyed areas of blossoms. Blister beetles were serious pests of sugar beets in Finney, Kearney, Scott and other counties.

Borers in elms and other shade trees were again numerous but the scorings show them to have been less destructive than in 1938. They were particularly severe in the northwestern part of the state which was the driest. The good rains in June resulted apparently in the destruction of many borer larvae and enabled the trees to recover somewhat from previous injuries. Borers were reported injuring elm, oak, ash, cottonwood, hackberry, locust, poplar, maple, red cedar and boxelder trees.

Common stalk borers (*Papaipema nebris* Gue!) were more numerous in Riley County during 1939 than in 1938. The larvae were collectant during June in grasses, corn, sweet clover and castor bean.

The **corn seed beetle** (*Agonoderus pallipes* Fabr.) was more plentiful at lights and in flights particularly in Riley, Finney and Coffey Counties than in 1938 but in both years they were below normal numbers. The only damage reported was to germinating milo seed during July at Hugoton.

Bot flies were probably less numerous and destructive than in 1938, probably because county agents reported that 19,385 horses were treated in Kansas in 1939 against 17,121 in 1938. This is particularly true in the western half of the state where horses are used

chiefly for herding cattle. Bots have been worst in southeastern counties.

Boxelder bugs were active during the warmer days of March and had scattered from their hibernating quarters by April 3. They were more annoying in previous years but the population in general is still well below that of peak years.

These bugs were practically absent during the summer but they collected in about the same numbers as were present in the spring at their favorite hibernating places for over-wintering.

Cactus borers (*Melitara dentata* Grote.) did more injury to cactus plants all over the state than for many years. Practically every cactus plant was attacked during the summer, the majority of them being severely riddled. The bluish caterpillar of the above species was by far the most plentiful species involved. These caterpillars spun silken cocoons either in the hollowed leaves or in the roots when grown. A Cerambycid larva, probably *Monolema annulatum* Say, was observed by Mr. Roy Fritz in Scott and Logan Counties to have been more numerous than ever before and many cactus clumps were destroyed by them. The larva bored into the main root or crown of plants. Two uncommon Syrphid flies (*Copestylum marginatum* and *Volucella* sp.) were reared from western Kansas plants in large numbers. The larvae lived in the empty burrows made by other insects.

Canker worms occurred in the biggest outbreak for many years in the eastern half of Kansas during the spring of 1939 and caused extensive defoliation of elms, hackberry, boxelder, and apple trees as far west as Ellsworth. Both the fall and spring cankerworms were delayed by the drouth in their emergence in Riley County, according to Dr. R. L. Parker. The peak of the emergence of the fall species occurred on March 8 and of the spring cankerworm on April 1st. Defoliation was particularly severe in the Neosho and Verdigris river valleys.

The outbreak was particularly severe around Kansas City and in McPherson and Saline Counties but not in Manhattan and Clay Center. Their absence in these two towns demonstrated the value of banding and spraying during previous years. Elms along creek banks and in small wooded areas were in many cases completely defoliated. Such conditions were observed in Riley, Reno, Rice, Saline, Dickinson, Clay, Pottawatomie, Shawnee, Jefferson, Leavenworth, Atchison, Wyandotte, Lyon, Osage, Jackson, Johnson and Douglas Counties. Apple trees were severely attacked in Doniphan, Atchison, Brown, Johnson, Franklin, Cowley, Sumner and Pottawatomie Counties. Chinese elms were attacked for the first time so far as known, in Atchison County. Only poorly cared for orchards had severe defoliation and the values of banding and spraying were never more in evidence.

Their Carabid enemy, *Calosoma scrutator* was particularly plentiful also.

The larvae were nearly full grown in Riley and surrounding counties by May 15. The rains of early June enabled the trees to put out a good crop of leaves during the month.

The carrot beetle (*Ligyrus gibbosus*) was abundant in Riley at lights during May and again caused injury in the western part of the state during August and September. Tomatoes and celery were killed in some gardens.

Cattle grubs were more numerous in the state during 1939 than for many years. The county agents reported that 1635 farmers applied control measures to 23,603 cattle in 1939 against 1492 farmers and 11,956 cattle in 1938. Many cattlemen had difficulty marketing grubby cattle in the spring.

Cattle grubs were most numerous in the Flint Hills pasture section of eastern Kansas. The flies were first observed causing cattle to run on March 26 in Wabaunsee and Riley Counties, on April 9 in Dickinson County.

Starlings attacked cattle during the time snow covered the ground December 26, 1939, to about February 15, 1940. Food was scarce for them as was true for many birds. Larger flocks of starlings were common around herds of cattle in stalk fields and feeding lots than were ever seen before. The birds alighted on the backs of cattle, in some cases to feed upon cattle grubs but in other cases to peck at scratches, wounds, recent brands, and warble tumors. Many animals had areas the size of a hand where the skin had been removed by the starlings. Wounds could not heal because of their persistent attacks. Cattle were injured in their efforts to escape the attacks of the birds which followed them closely. Meadow larks also occurred with the starlings and were reported probably incorrectly doing similar injury. Many reports were received chiefly from the southern part of the state and in particular Chase, Rice, Morris, Harvey, Meade, Russell and Riley Counties.

The common cabbage worm, though more numerous than in 1938, was somewhat less destructive than in previous years. Injury was reported only in eastern Kansas, in the Arkansas River valley and the northern tier of counties in the west. Rain during June favored the growth of cabbage.

Codling moths were apparently more numerous in the apple district of northeastern Kansas in 1939 than in 1938. The catches at bait traps reported by P. G. Lamerson at Troy and Wathena were consistently two to seven times greater in 1939 from early May to September 30 than in 1938. Only during June were fewer moths taken.

The Colorado potato beetle was more plentiful and destructive

than usual during June. The first generation was exceptionally large.

Corn bill bugs were considerably less plentiful and destructive in 1939 than in 1938. They occurred chiefly in the eastern half of the state especially in the southern quarter. It is believed that rotation of crops on bottom lands has reduced their numbers.

Chinch bugs, after a relatively unimportant first generation, built up to the largest numbers in 10 years in the second generation and went into hibernation in the fall. During April, 10-15 bugs occurred to a clump of native grasses over most all of the eastern half of the state. They were scarce in southeastern Kansas but more plentiful north of the Kaw. The relatively few survivors from the severe winter scattered late to thin spots in wheat and barley fields. Egg laying was delayed by the cold spring to late May. The first generation was of sufficient size in many eastern counties especially north of the Kaw river to cause farmers to purchase barrier material. They were most threatening in Brown, Nemaha and Marshall counties. However, there were few migrations from wheat fields by crawling. The bugs matured in grain fields especially on "fox tail" and flew to sorghum and corn fields. Widespread and occasionally serious injury was done to many sorghum fields by these adult bugs. Young milo and replanted sorghum plants were severely attacked and some were seriously affected especially in 12 northeastern counties. Sorghum plots at the college farm were saved only by heroic control efforts but the stands were reduced and growth delayed. Barriers did not yield the protection usually expected because the bugs scattered by flight instead of on foot.

The second generation was a large one and caused heavy loss to corn and sorghum. Fall weather was favorable and maturing bugs were seen in greater numbers than for many years seeking winter quarters from the last of August to early October. Adult chinch bugs were everywhere. They were taken frequently in homes. For the first time in many years, adult chinch bugs damaged sorghums particularly in southeastern Kansas during the fall.

The chinch bug situation appeared so threatening in the fall of 1939 that the U. S. Bureau of Entomology and Plant Quarantine made a fall survey. In short, the largest population in years was discovered in hibernation in 50 counties east of highway 81. The western limits of the larger number extended to Jewell, Cloud, Sedgwick and Sumner Counties. As many as 3000 bugs to the square foot were found as far west as Washington and Clay Counties.

Crambid moths were distinctly less plentiful at lights and in grass during 1939 than in 1938. Larvae were difficult to find.

Cutworms of the usual species occurring early in the state were almost completely absent in the spring of 1939 all over the state. Most species were less plentiful than for years. It is believed that

they have been reduced by parasites and hot, dry weather.

The most plentiful was the **pale western cutworm** which, according to H. H. Walkden, was again in outbreak numbers in western and northwestern Kansas and was responsible for killing some 10,000 acres of wheat. His surveys of the situation indicated that they were as plentiful as last year and in approximately the same counties. Heaviest injury to wheat and barley occurred in April and May in Rawlins and Thomas Counties, but losses were reported also from Gove and Meade Counties. Wheat on fallowed land was injured only when near stubble fields. Many patches of dead wheat in most central western Kansas fields were thought to have been results of feeding by this species. There was a heavy flight of moths of this species in Rawlins and Thomas Counties in September, according to Mr. Walkden.

Wheat head army worms were present in larger numbers than usual and some injury up to 25 percent was done to wheat in Morris County during early June. However, in the state as a whole there was little or no commercial damage done.

The **army cut worm** was the scarcest in years. Few specimens were seen.

Corn ear worms did widespread curl damage to corn in early June. This species attained normal numbers or more during the latter part of August on late sweet and field corn and in alfalfa. The moths were unusually plentiful hiding in shrubbery and grassy lawns in early September. The larvae were about as plentiful in fall growth of alfalfa as occurs in peak years. Late planted corn was practically 100 percent injured by the larvae. They also damaged sorghum heads in the fall.

The **variegated cut worm** was fairly plentiful though below normal in certain alfalfa fields in Riley County the last of May. As usual, they were most plentiful in some bottom fields where the growth was tall enough to shade the ground. They were heavily parasitized by Tachinids. No injury was seen nor reported.

Black Crickets were again annoying in homes but probably fewer reports came in than in 1938.

Common field crickets again damaged the seed crop of alfalfa in Garden City area. As much as 50 percent loss was experienced from crickets cutting off the heads and eating the seed while the curing seed stalks were in piles in the fields. The crickets were half grown and extremely numerous by early July. One could readily find as many as 15 to 20 to the square yard.

False wire worms (*Eleodes opaca* and *E. coloradensis*) were again plentiful and destructive to fall sown wheat in extensive areas in western Kansas. The exceptionally severe drouth during September favored the species and greatly extended the loss. False wire

worms have extended their range eastward. Heavy populations were seen in Dickinson, McPherson, Ottawa, Saline, Republic, Cloud and Clay Counties. It was estimated that over 600,000 acres of wheat had to be replanted in the fall of 1938; some were planted to barley both in the fall and spring and an estimated 200,000 acres were planted to corn and kafir in the spring of 1939.

Fleas in houses, in barn lots and on pets caused more inquiries than usual.

Biting flies (horn and stable) occurred in several outbreaks of relatively short duration and were as numerous in the state as in the more severe fly years. The stable fly caused annoyance to stock in southeastern counties as early as April 20. A widespread outbreak occurred during May and June with stock losses in southcentral counties.

Horse flies (Tabanids) were less plentiful in 1939 than in 1938. They were present in largest numbers along streams in southeastern Kansas in July. Traps in Butler and Elk Counties caught large numbers in July and August.

Screw worm flies were again in outbreak in Kansas in 1939 particularly in the eastern half of the state. Screw worms were brought into the state from southern Texas and New Mexico by shipments of some 50,000 cattle reaching Lyon and Greenwood Counties April 17. They had been dehorned before shipping and these wounds as well as those resulting from castration and scratches were badly infested. While these animals were examined and treated with benzol, complete control was not obtained. The flies then attacked young calves and other animals in Cowley, Butler, Sumner, and Chautauqua Counties. An outbreak developed in Meade County in dehorned cattle shipped from New Mexico during early June. A man was known to have been treated for screw worm flies. Some 5,000 cattle were treated with a mixture of honey, pine tar and crysillic acid with excellent results. Sheep were attacked in Cowley, Lyon, Potawatamie, and Sumner Counties; hogs in Sumner and Butler. Screw worms continued to be a pest in the state in eastern Kansas until the middle of October.

Grasshoppers were less numerous in Kansas in 1939 than in 1938 but they were in outbreak in western and especially southwestern counties. The adult and egg survey in the fall of 1938 indicated that they would occur in some 65 western counties.

The distribution of nymphs in April and May was general, being heaviest, however, in the western half of the state. Populations up to 400 nymphs to the square foot were reported and a widespread severe outbreak appeared certain in 60 or more counties.

Excellent rains in May and June caused the fungus disease to develop practically over the entire state which was an effective

control in 12 central counties extending to and including Republic, Saline, McPherson, Reno and Pratt Counties. The early picture in the border area changed remarkably from June to August.

M. mexicanus, the migratory grasshopper, was the most numerous and wide spread species. The eggs were largely hatched by the middle of May and the nymphs were doing damage by the middle of June. The species occurred at the edges of fields, in wheat, oats and barley stubble and in wheat fields where stubble and trash were left on the fields. Flights by this species were observed and reported in early July in Wallace, Logan, Johnson, Sherman, Hamilton, Greeley, Finney, Scott, Meade, Haskell, and Seward Counties. As many as 450 grasshoppers per square foot, 94 percent of which were *mexicanus* were observed alighting near Garden City. The second generation of this species began appearing the last weeks of July but many perished for a lack of food.

Aeoloplus turnbulli bruneri, the thistle hopper, followed a similar life cycle and approached the migratory species in numbers and damage. This hopper is however a western species and was the dominant species in the northwest from Mankato west to Medicine Lodge northwestward. They were particularly injurious to sugar beets in the Garden City area. They damaged wheat by cutting off the ripening heads. This species is spreading eastward. The rapid increase of this species the last three years is an outstanding feature. It had no important parasitic enemies. It clustered on Russian thistle and lays its eggs under them. Its eggs do not dry out.

Melanoplus differentialis, the differential grasshopper, was somewhat less plentiful than normal and caused little damage in the state.

M. bivittatus, the two lined hopper, was the dominant species in Central and Eastern Kansas. The first adults occurred in July. The nymphs cut off many heads in Finney and Seward Counties, according to Mr. Roy Fritz, causing severe loss.

The longwinged plains hopper was not a pest in the state in 1939, but was observed in Mitchell, Jewell, and Stafford Counties.

Climatic and other natural forces were primarily responsible for reduction of grasshoppers to harmless numbers in the eastern half of the state. Rains in June favored development of diseases which apparently destroyed many hoppers in the eastern half of the state. Thistle hoppers killed by the fungus were seen in Wallace County in July. There were not enough hoppers around Manhattan for experimental work.

Some 3,048,000 acres were tilled by 25,684 farmers in the state to destroy the eggs and young hoppers with good results.

There were used in Kansas, during the summer and fall of 1939, 84,531 sacks or 8,800,000 pounds of wet mixed bait by farmers in 1939 and 2,634,000 pounds of dry mixed bait by the federally employ-

ed men in eight southwestern counties designated as the "longipennis" area. Thirteen thousand three hundred and ninety-four farmers spread 8,800,000 pounds with the use of 640 mechanical spreaders and their own hands on 880,000 acres protected thereby 3,459,638 acres at a cost of \$70,000 saving crops valued at \$3,668,000. These amounts are from one-third to one-fourth of the amounts used last year indicating the smaller grasshopper population of 1939.

The fall (1939) survey indicated that more eggs were in the ground in the western third of the state than at any time since 1935. Egg deposition was heaviest in Lane, Hodgeman and Greeley Counties.

Green June Beetles (*Cotinus nitida*) were more numerous in eastern Kansas than in 1938. They were reported eating the leaves and fruit of peach and other fruits at Arkansas City and Topeka during July. Newspaper accounts reported them incorrectly as Japanese beetles which are now not known to occur in this state.

Harlequin cabbage bugs were more abundant than in 1938. Turnips and cabbage were reported injured at Hutchinson and in southeastern Kansas Counties. They were abnormally plentiful in Riley County during August but no damage was done.

Hessian fly had a relatively low population and did no damage except in extreme southeastern counties. The overwintering population was heavier than in 1938. Adults emerged in April and May and a somewhat larger spring brood than for about five years resulted. The numbers however were barely enough to cause commercial losses except in Cowley, Chautauqua, Dickinson, Montgomery and Marion Counties. R. H. Painter and E. T. Jones found relatively few stalks down however and large numbers of parasites. It was apparent that the fly was building up.

The extreme drouth of the summer and fall was exceedingly unfavorable to this insect. By winter, surveys indicated that the hessian fly had been virtually wiped out. The year closed with a smaller than usual population in hibernation. However, Dr. Painter found as high as 50 to 60 percent of plants infested in his wheat nursery after fall rains in October. They must have emerged after October 10 which is a week beyond the fly free date.

Leafhoppers (*Erythroneura* spp.) were exceptionally plentiful the latter part of April in Riley County in Spiraeas, Japonicas, rose bushes and redbuds. Injury to wall paper and pictures especially oil paintings supposedly caused by leaf hoppers was observed in a Manhattan home. Oily spots near dead leaf hoppers offered some verification.

MITES AND TICKS

Wheat mites were again numerous and destructive on wheat throughout western Kansas. Dr. R. H. Painter observed that they

occurred alone in some fields but in others, red spider mites were also present. They were present in numbers in Ellsworth, Gove, Trego, Thomas, Rawlins, Cheyenne, Dickinson, Meade, Clark, Ford, Edwards and Finney Counties. Messrs. R. H. Painter and H. H. Walkden observed on surveys the middle of May that wheat mites occurred largely south of highway 24 but north of it they were largely replaced by red spiders.

Brown spots presumably the result of attacks by these mites were common in wheat and barley fields in the western half of the state. Edges of fields were more severely damaged than the centers. Drouth delayed growth of wheat and accentuated injuries. Injured wheat fell over and cured. Such spots were frequent around Garden City according to Mr. Roy Fritz and resembled drouth injury. It is believed that the hot summer weather of 1938 and 1939 destroyed many mite eggs.

Chiggers were fully as plentiful and annoying in 1939 as in 1938 particularly during June and July. Many letters concerning these pests came in. Yard dusting with sulphur was common but rains in June washed it off. They were a constant subject of conversation and newspaper publicity.

Sheep scab mites occurred during January in Cowley, Elk, Greenwood and Chautauqua counties in greater numbers than usual. An infested flock was sold and scattered at a sales pavilion.

Red spider mites were again more plentiful and destructive than normal from May to September in various parts of the state. During May, injuries were caused to wheat, especially north of highway 24 and to ornamentals. Heavy infestations occurred in late summer on evergreens in Riley County and many other eastern counties. They were less abundant in Dickinson County.

Clover mites were abundant in the Kaw Valley in April and some clover patches were killed by them. This species was more plentiful than usual in alfalfa fields during June.

Dermacentor nigrolineatus the red-brown winter tick was taken early in the spring on cattle from the south. It was first taken in Kansas in 1936 but this state is too far north for the species to survive the winters.

Several species of ticks were taken in Kansas for the first time as far as known. *Rhipicephalus sanguineus*, the brown dog tick became exceedingly plentiful around the veterinary clinic building and a Manhattan home became so heavily infested in September that a general fumigation was necessary. It is believed that this tick was introduced with southern dogs sent to the veterinary hospital for treatment. The residence possibly became infested from this source.

Ornithodoros talaje Duges was taken in a hotel in a Kansas town. The ticks were reported crawling on the walls and dropping on beds.

They were identified by F. C. Bishop who stated they were usually associated with bats and rodents. Some live specimens were sent in in rubbing alcohol. Upon receipt, they were removed from the alcohol, washed in tap water and after a delay of some three days, three or four of the ticks attached themselves to a rabbit and fed.

Mosquitoes were more numerous in 1939 than in 1938. They built up to abnormal numbers as a result of June rains and continued plentiful until October. Egg masses were readily found in water filled receptacles all summer in Riley County. There was a virtual outbreak of mosquitoes the latter part of June in the Neosho and Marais de Cygnes river valleys. Apple pickers in northeast Kansas were severely attacked in late summer.

Equine encephalomyelitis considered by many to be mosquito borne was less prevalent in the state than in 1939. There were 727 cases during the summer in the state of which 121 resulted fatally

Onion plant bugs were somewhat numerous during 1939 but there was little loss to onions in spite of rather severe top injury. They appeared in destructive numbers about May 20 in Riley County but left about June 1. Onions were favored by good growing conditions and soon overcame largely an injury that might have killed the onion in less favorable years. The bugs were last seen on the tops of wild onions.

A small Pentatomid bug of unknown species was reported attacking beets and melons in Meade County during early June. The same or a similar species attacked wheat in Jewell County. Several species of these bugs were unusually plentiful in alfalfa fields during September in Riley County.

A flight of pentatomids (*Thyanta custator*) occurred at Hutchinson September 15 from 11:30 to 2 o'clock and at Oakley on September 19.

Small pentatomids attacked wheat in June. They were common on wheat heads and there were some indications that they fed on the developing kernels.

The abnormal abundance of Pentatomids during 1939 has prompted some to call it a "Pentatomid year."

The rose budworm destroyed a high percentage of rose buds on untreated roses during May and June in Riley County. It was perhaps less plentiful than in 1938.

Cedar Scale (*Cryptaspidotus shasta*) was as abundant and destructive in Riley, Phillips, Norton, Clay, Dickinson, McPherson, and Finney Counties during June and July as in 1938. All the cedar trees on the campus were sprayed June 1 and 2 and on June 30 to July 3 to destroy the crawling young. The outbreak in 1938 and 1939 is

regarded as the worst in a generation. Many wild cedars were killed by the scale. Spraying with 1 pint of nicotine sulphate in 100 gallons of water plus 1 quart of summer spray oil (Verdol was used) gave excellent results. No sprayed trees were killed by the scale. There are four generations of the scale during the year. It has been highly parasitized but parasites did not control it.

The **pine leaf scale** was reported by R. H. Beamer as unusually scarce in 1939.

The **American saw fly** (*Cimbex americana*) was less numerous during June than in 1938 but was plentiful enough to do some defoliation in southeast Kansas. The population was well above normal. Some elms were defoliated at Coffeyville in June.

The **rose sawfly** was practically absent in the state in 1939. Its numbers and injury were well below 1938 and less than normal. Only a few rose bushes were observed during May and June to have been attacked.

Silver fish were the subject of somewhat more than usual number of inquiries from many counties. Observations indicated, however, that the numbers in Riley County were normal.

Sheep nose bots were present in annoying numbers in various western counties in April and May. Adults also caused annoyance by deposition of young during July.

The **southern corn leaf beetle** (*Myrochrous denticollis* Lec.) was reported many times as doing damage to corn in southeastern Kansas south of Garnett the latter half of May. Several hundred acres were reported damaged.

The **striped cucumber beetles** were definitely less numerous and destructive than last year. A good crop of cucumbers was harvested in July from the departmental plots as a result of frequent dustings with Pyrocid "10" and in spite of the drouth. The vines finally succumbed to the wilt disease however. This beetle was unusually abundant on late squash in October.

The **12-spotted cucumber beetle** was more abundant during September than for a number of years. They caused some damage to late squashes, flowers and buds of late fall roses, chrysanthemums and other fall flowers.

"**Stored grain insect pests** were more abundant in Kansas during 1939 than they have been at any time during the past 20 years" according to Dr. R. T. Cotton. "Of 1,147 cars of grain inspected on the Kansas City market in November, 33 percent graded weevily. A survey of farm stored grain in Saline County showed that at the end of November, 93 percent were infested. The insects more frequently found were, the flat grain beetle, the Cadelle, the sawtoothed grain beetle, the rice weevil and the granary weevil.

The Tenebrionids *Cynaesus angustus* Lec. and *Tenebrio picipes*

Hbst. were found infesting grain in Riley County. The former species has never before been recorded as a pest of stored grain. The latter species has been recorded occasionally in the United States and Japan as a pest of stored cereals, but, has not been previously infesting grain in Kansas."

The **sugar cane root stalk weevil** (*Anacentrinus deplanatus* Csy). was discovered by Prof. H. R. Bryson causing injury for the first time in Kansas to some kinds of sorghum during August in Riley County. This weevil was previously collected in the county on barnyard grass.

Squash bugs (*Anasa tristis*) were again so plentiful in Riley County and other truck growing areas as to be the limiting factor on the crop. Both squash and pumpkin vines were killed promptly during July and August but the bugs clustered on the fruits after the vines were killed. While they were the most serious pests of these crops in 1939 they were not quite so plentiful as in 1938.

Tarnished plant bugs passed the winter of 1938 in larger numbers than usual and were common in alfalfa fields and at lights in Riley County the latter part of March. The adults were in flight on warm days throughout March. The first generation was nearly grown the middle of May. It was thought the paucity of flowers on the first growth of alfalfa may have been connected with the large numbers of this species. Injury was reported from south east Kansas.

Tomato horn worms were slightly more numerous and destructive than in 1938 but their numbers were perhaps below normal. They were reported causing damage at Jewell, Hutchinson and Manhattan during August.

Termites continued to be a major subject of correspondence but it is unlikely that they were more numerous or more destructive than in 1938. The earliest swarms emerged in Riley County March 12 and continued daily for a week. Rains in June caused increased activity giving the impression that they were more abundant than usual. Swarms were seen on September 30 and October 14. Damage to living trees and other vegetation continued to constitute an increasing proportion of the injuries and reports. This is a major problem in the state. They killed year old apricot trees in Barton County and Chinese elms at Downs in April.

Walnut worms were less numerous and destructive in the state than usual. The first generation of larvae defoliated some trees particularly in Southeast Kansas during July being most pronounced from Greenwood County east. The second generation in August did about the same amount of defoliation and the same general region. This insect was scarce in Riley County.

The **beet webworm** was plentiful in all western Kansas counties during August but foliage injury was largely confined to Russian

thistles but some young alfalfa was injured. They were particularly plentiful at Hays and Ellis.

The **garden webworm** had about the usual population. A few larvae were readily found during August and September. They were reported injuring alfalfa in Barton County in September and to developing seed crops at Halstead.

Wheat saw fly larvae were reported by Dr. R. H. Painter to have been abundant in wheat in Ellsworth and Cheyenne Counties during May. The numbers were below normal and below 1938.

The **wheat stem maggot** was at a low point in its cyclic population curve in Riley County according to Dr. R. H. Painter. They were abundant, however, in the experimental fields early in June in Cherokee and Neosho Counties. "White heads" were readily seen in fields throughout southeastern Kansas.

Wheel bugs (*Arilus cristatus* Linn.) and *Triatoma sanguisuga* were exceptionally plentiful during 1939 as judged by specimens of the former sent in by correspondents and by collected specimens of the latter in Riley County.

White grubs were less plentiful in 1939 than in 1938. No serious damage resulted anywhere in the state except that of the **wheat white grub** in south central Kansas. This outbreak was described in the 1938 summary and since that wheat was harvested in June 1939 the loss due to that outbreak was largely realized in 1939. This insect was especially abundant in Sedgwick, Harper, Reno, and Rice Counties.

Mr. Roy Fritz reported collecting adults of this species on Finney and Seward Counties which is believed to represent a south western extension of the range of this species. This species was again abundant during September in south central Kansas but because of the lateness of the wheat sowing, not much damage was done. The adults were unusually plentiful during July at the Manhattan Country Club. They are apparently increasing there. June rains largely overcame earlier injury to the grass there.

Common white grubs were observed by Professor Bryson to be most numerous in April and May in gardens, strawberry patches, and grassy plots. Adult Phyllophaga were late in emerging for flight in Riley County appearing, however, near the end of May.

Slight injury to fall sown wheat and to blue grass lawns occurred in Riley County in September.

Wireworms (*Aeolus dorsalis*) were observed by Prof. H. R. Bryson to be numerous in some wheat fields of Geary County in March and April but no injury was done.

SUMMARY AND CONCLUSIONS

Kansas in 1939 had the third warmest and fifth driest year in the 53 years of statewide weather records. Prolonged drouth from the

latter part of August to the closing days of December was the most severe on record for the time of year. Practically every section of the state received less than normal precipitation for the year. The average by sections was 26.54 inches, eastern third; 20.91 inches, middle third; and 12.79, western third. This was the ninth year in the drouth cycle which began in 1930. For the whole state the average moisture fall was 20.08 inches, or 6.35 inches below normal and 7.21 inches less than the 1938 average. June had the heaviest rainfall for 50 years causing losses by floods to wheat at harvest time and loss by shattering because of delayed cutting. The temperature was cool and pleasant but humidity was higher than usual. More snow fell this year than in any since 1924. It was unusually heavy late in February and the last days of December. Average temperature for the year was 57.8 degrees, 2.9 above normal and only 0.7 degrees cooler than the warmest year of record, 1934.

The following insects were in **outbreak** in 1939; green bug, pea aphid, elm leaf aphid, blister beetles, canker worms, pale western cut worm, false wire worms, screwworm flies, grasshoppers (west only), brown mites, red spiders, chiggers, cedar scale, squash bugs and wheat white grubs (spring).

The following forms and most of these mentioned above were **more numerous** in 1939 than in 1938: corn seed beetle, ailarthus web worm, boxelder aphid, cabbage aphid, cotton wood petiole gall aphid, apple leaf skeletonizers, common stalk borer, boxelder bugs, cattle grubs, codling moths, Colorado potato beetles, chinch bugs (fall), wheat head army worms, fleas, green June beetles, harlequin bugs, chiggers, clover mites, common pentatomids, silver fish, tarnished plant bugs, tomato horn worms, wheel bugs and Triatomas and stored wheat pests.

The following insects were approximately as **plentiful** in 1939 as in 1938; yellow ants, alfalfa caterpillars, carrot beetles, clover leaf weevils, pale western cut worm, corn ear worm, variegated cut worm, black crickets, false wire worms, wheat white grub, biting flies, screw-worm flies, leaf hoppers on grape, wood bine, spiraeas, and roses, brown mites, red spiders, rose slugs, cedar scale, southern corn root worm, termites, beet and garden web worms.

The following insects were **scarce or practically absent** in 1939: cutworms especially army and common garden species, hessian fly (in spring), rose sawfly, wheat stem maggot.

The following species in addition to those above were **less plentiful** in 1939 than in 1938: house ants, kafir ant, melon aphid, blister beetles, flat headed and other borers, grasshoppers, hessian fly (in fall), horse flies, onion plant bug, peacock butterfly, rose bud worm, American saw fly, striped cucumber beetle, squash bugs, walnut worms, wheat saw fly, white grubs and wireworms.

GRASSHOPPER POPULATIONS (ORTHOPTERA,
ACRIDIDAE) OF TYPICAL PASTURES IN
THE BLUESTEM REGION OF KANSAS*

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Studies of the prairie grasslands by Weaver (1931) and others indicate that the prairie is rapidly losing ground in its struggle against the encroachments of the plow. In certain of the prairie states, the remaining stands of native grasslands are largely confined to narrow railroad right-of-way, fence rows, and roadsides. However in the Flint Hills or Bluestem region, which extends north and south through the middle of the eastern fourth of Kansas, a large portion of the soil is still covered with its natural heritage of bluestem grasses. Much of this bluestem area has been pastured or mowed but in the main is in a fair state of preservation in spite of occasional or even frequent mistreatments by overgrazing. Being the last large remaining stand of prairie grasses it undoubtedly bears the most representative fauna of the original prairie that can be found under present conditions. Outstanding and conspicuous among the insect fauna of the prairie are the grasshopper of the orthopteran family Acrididae.

LITERATURE. In Kansas the only intensive survey of the grasshoppers inhabiting the native grasses was that made by Woodruff (1937) who collected in a native bluestem meadow, a corn field and alfalfa field, and a weed patch through July until August 21 of 1936. He noted that the native grasslands supported a quite different grasshopper fauna from the other habitats in that the genera *Orphulella*, *Mermiria*, and *Syrbula* were dominant in the prairie though scarce elsewhere. In the cultivated areas species of the genus *Melanoplus* were dominant.

After analyzing the collections taken during the annual grasshopper surveys of the state, Shotwell (1938a, 1939) recorded the species according to habitats, including those occurring in pastures. His pastures were, however, largely grazing lands in the western part of the state and were not representative of the bluestem pastures of the tall grass prairie.

Injury to the heads of native grasses was observed by Wilbur (1936) in 1932. Similar injury tho to a lesser degree has been noted each year since. The insect attack was such that the injured heads

*Contribution No. 494 from the Department of Entomology.

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withered and failed to produce seeds.

A list of the Orthoptera collected from a large tract of native prairie near Lincoln, Nebraska, was published by Whelan (1938). This area is similar to the one on our college farm which is called the native grass pasture in this paper. Whelan listed 32 species of Acrididae, 11 of which were mentioned as being common.

Hendrickson (1930) collected all of the insects from a series of native prairie habitats in Iowa and obtained a large series of grasshoppers. An ecological survey of the Orthoptera of Oklahoma was summarized by Hebard (1938) who listed the collections from grasslands under pasture and range. Neither of these habitats corresponds to the bluestem prairies in Kansas. Isely (1937, 1938) studied the food habits of acridians of Northeastern Texas, many of which are an important part of the acridian fauna of Eastern Kansas. Acridians of the grasslands were included in a series of habitat collections made by Horsfall, Dowell and Palm (1933) in Northwestern Arkansas. All of these papers emphasized the differences between the grasshopper populations of native grasses and of crops in both numbers and species.

GRASSLANDS UNDER OBSERVATION. Some years ago a study of the insect fauna of grasslands was begun at the Kansas Agricultural Experiment Station. The purpose of the study was to determine the insects present, their biology and behavior, and the fluctuations in their populations as affected by weather, grazing methods, and other factors. As a part of this study three grassland areas located in the Animal Husbandry pastures were selected for continuous and systematic sampling throughout the growing season for a period of years. The areas selected were tracts of 40 acres or more and consisted of native prairie grass, Kentucky bluegrass, and orchard-brome grass pastures. From a study of the insects of the native prairie area it was hoped to determine to some extent the insect fauna of the original prairie of this section. All relationships between the insects of the grasslands and the insects of the adjoining crops were noted. The following report largely concerns the grasshoppers secured during the collections for the seven years beginning 1933 and continuing through 1939.

The native prairie pasture was as good an example of Weaver's upland prairie as could be found in this region. The dominant grasses were little bluestem (*Andropogon scoparius*) and big bluestem (*A. furcatus*) with varying amounts of side oats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), prairie dropseed (*Sporobolus asper* and *S. heterolepis*), prairie June grass (*Koeleria cristata*), and others. Apparently the only introduced grass was Kentucky bluegrass (*Poa pratensis*) which disappeared entirely during the drouth of 1934. Native herbs were scattered throughout the pasture.

The pasture was grazed intermittently each year and for a time showed the effects of the 1934 drouth but at present shows little evidence of natural or artificial mistreatment. This pasture has been burned off both by accident and by intent on different occasions during the years of observation.

The area considered as the Kentucky bluegrass pasture started out with a fine stand of this grass but the drouth of 1934 practically eliminated it. Only a small quantity remained after the fall of 1934, its place being taken by a succession of weeds and annual grasses. Mustards came in first and were prominent among the weeds but disappeared almost entirely following a severe aphid infestation. Annual grasses followed quickly, particularly little barley (*Hordeum pusillum*) and annual brome (*Bromus secalinus*). Then came a heavy growth of love grass (*Eragrostis* spp.) and at present prairie dropseed is becoming established in abundance. The Kentucky bluegrass has scarcely gained during the past five years.

The orchard-brome grass pasture consisted of those cultivated grasses recommended for seeding in this area. The original area observed was a stand which very successfully resisted both the drouth and the heavy grazing. However, it was turned under in 1938. Observations were continued on a newly planted field of orchard-brome grass across the road from the original plot.

METHODS. Each year the collections were started during April, the exact time depending on collecting conditions, and were continued throughout the growing season until severe frosts occurred. Semi-weekly collections were intended but occasionally rains interfered. Most collections were made between 11:00 A. M. and 2:00 P. M.

The collecting was done by means of a specially constructed, long-handled, square net, the mouth of which was one square foot in area. Twenty-five sweeps of this net in each plot, each sweep covering about three feet, constituted a collection.

Numerous criticisms have been leveled at the sweep method as a means of evaluating insect population. The writers certainly do not propose this as the best means of surveying grasshoppers, the methods devised by Shotwell (1935, 1938b) being much superior. The sweep method, however, does make it possible for a busy entomologist to keep in touch with many of the events and trends in the field that would otherwise escape him. It likewise appears entirely adequate for population studies when large numbers are treated and when conclusions are not drawn from minor differences.

A large series of the grasshoppers collected during the first two years were identified by Hebard, who published the records along with others from the Kansas State College collection (1934) as an addition to his Orthoptera of Kansas (1931). Later specimens were identified by members of our own laboratory. We have been unable to distin-

guish with certainty some of the species, particularly *Orphulella speciosa* and *O. pelidna*, and the females of *Melanoplus femur-rubrum*, *M. mexicanus* and *M. confusus*. The *Orphulella* species were grouped, and the females of *Melanoplus* were distributed in accordance with the prevailing number of males.

WEATHER. As it developed, the project was started at the beginning of the hottest and most severe period of drouth on record in Kansas. The following indicates the extent of this drouth as recorded at Manhattan:

1933—rainfall deficient 9.55 inches from a 53-year average; 27 days of 100° F. or more; severe June drouth.

1934—rainfall deficient 12.11 inches; 64 days of 100° F. or more and 23 days of 110° F. or more; 3½ months of most severe drouth beginning May 15.

1935—rainfall excessive 6.22 inches; 33 days of 100° F. or more, wet spring and wet fall but 48 days beginning July 1 until August 18 with only 0.2 inches of rainfall.

1936—rainfall deficient 8.42 inches; 60 days of 100° F. or more severe drouth during growing period. Beginning May 26 and ending August 19 only 1.47 inches of rainfall.

1937—rainfall deficient 11.15 inches; 38 days of 100° F. or more, only two rains of more than 0.71 inch occurred during the entire growing season and these were cloudbursts.

1938—rainfall deficient 4.09 inches; 20 days of 100° F. or more, severe drouth in September and October.

1939—rainfall deficient 4.23 inches; 18 days of 100° F. or more, severe fall drouth.

It can be seen that during the period of these collections, there has been a shortage of 43.33 inches of moisture which is approximately 20 percent below the amount expected from the 53 year average. Also 260 days or 10 percent of the total number of days have had temperatures of 100° F. or more.

POPULATIONS OF NYMPHS. During the seven years period 13,937 nymphs and 5,444 adults of grasshoppers were taken. The number of nymphs is believed to be fairly indicative of the 'hopper populations because they were easily captured by the sweep method. As the observations progressed the nymphs of several of the species could be distinguished, but as this was not done in the earlier collections, the nymphs are therefore treated as a group. The distribution of nymphs according to years and habitats is given in Table 1:

The meadow grasshopper completely disappeared following the 1934 season, but in 1939, a fairly large collection was taken from each of the three pastures.

TABLE 1

The distribution of grasshopper nymphs by years and by habitats.

Year	Native Prairie	Kentucky Bluegrass	Orchard Brome	Total
1933	2346	463	617	3426
1934	1175	491	589	2255
1935	287	183	117	587
1936	651	543	1309	2503
1937	459	910	1106	2475
1938	315	793	474	1582
1939	405	388	316	1109
Total	5,638	3,771	4,528	13,937

This is in striking contrast to the populations of the nymphs of the meadow grasshoppers of the family Tettigoniidae as indicated in Table 2.

TABLE 2

Distribution of nymphs of Tettigoniidae by years and by habitats.

Year	Native Prairie	Kentucky Bluegrass	Orchard Brome	Total
1933	71	190	363	624
1934	0	5	3	8
1935	0	0	0	0
1936	0	0	0	0
1937	1	0	0	1
1938	4	0	1	5
1939	27	16	85	128
Total	103	211	452	766

From Tables 1 and 2, it is evident that the year 1933, before the serious drouth set in, carried the largest nymphal populations of both acridians and meadow grasshoppers. Yet in this part of the state there was no problem of grasshopper injury to crops until 1935. The smallest collection of nymphs for the seven-year period was taken during 1935. This suggests that numbers of grasshoppers in the grasslands cannot be depended on as an index of possible injury to crops by grasshoppers. The reason for this will be apparent when the dominant species for the different years are discussed.

In Figure I is presented bar graphs of the nymphs collected for the entire seven years. Each bar represents the day's collection from the three grassland areas and thus consists of the acridians captured by 75 sweeps of the net. Only the general pattern of the charts should be considered and these simply to indicate trends. The uneven nature of some of the curves may be attributed to the weather, to a peculiar behavior on the part of the grasshoppers or to chance. No explanation is offered for such unusual collections as those especially large ones taken early in June of 1934 and in the middle of June of 1938.

The pattern of the 1933 collection is reasonably regular in outline and represents a nymphal population which starts in late April, progresses slowly through May and reaches a peak through June and early July, when it recedes quickly. A small nymphal population is maintained through August and well into September. A similar pattern is maintained during the years 1936, 1938, and 1939 with only minor differences.

In 1935, the year of least abundance of nymphs, no peak is evident. It was during this year that nearly 15 inches of rainfall occurred in May and June. At the time, it was thought that there would not be a grasshopper problem because of such an excess of moisture and because of subnormal temperatures. The lack of a heavier spring hatch is probably due to the large hatch which occurred during the late summer and fall of 1934, too late for the individuals to mature and deposit eggs.

The nymphal populations of 1934 and 1937 are quite out of line with those of the other years. Two distinct peaks of nymphal abundance occurred during 1934. A population similar to that of 1933, except for reduced numbers, was present during May and June and practically terminated by the middle of July. On the second and third of September two rains totaling 1.33 inches occurred to break a terrible drouth of three and one-half months. During this drouth there were only two showers of more than half an inch of rainfall, and these were of less than 0.65 inch. Immediately following these early September rains, a second major hatch of grasshoppers occurred and nymphs were present throughout the mild fall until they were destroyed by freezes in November. The extent of this late hatch was 28.6 percent of the total season's collection (Table 3).

In 1937, collected material showed an irregular peak from late May until early July and included a considerable number of nymphs throughout August and into September.

TABLE 3

Percentage of acridian nymphs collected after July 31.

Year	Percentage of nymphs after July 31
1933	4.15
1934	28.60
1935	9.37
1936	4.95
1937	16.52
1938	5.82
1939	1.98

Two explanations are suggested for the unusual hatches of 1934. It has long been known that in certain years *Melanoplus mexicanus*

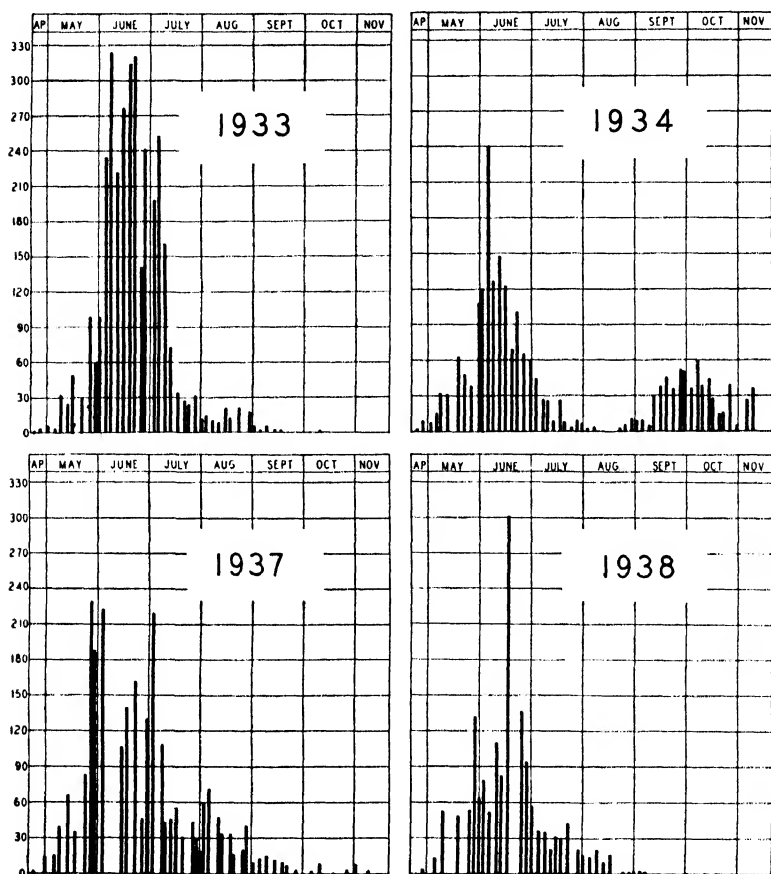


FIGURE I

has a second generation. Most of the nymphs recorded during the late summer and fall for each of the seven years were of this species. Certain of the Oedipodinae formed most of the exceptions and these exceptions were few in numbers. It is possible that the excessive drouth of the latter half of May, and of June, July, and August may have interrupted the normal spring hatch of *M. mexicanus* and that the remaining eggs awaited the rains of early September for further development. However, it seems more probable that the September hatch represented a partial second generation. A diapause broken by winter's cold characterized the development of the eggs of most grasshopper species. Normal winter hardening results when excessive water in the protoplasm is thrown off, creating a condition of physiological drouth. In the absence of experimental data, it seems

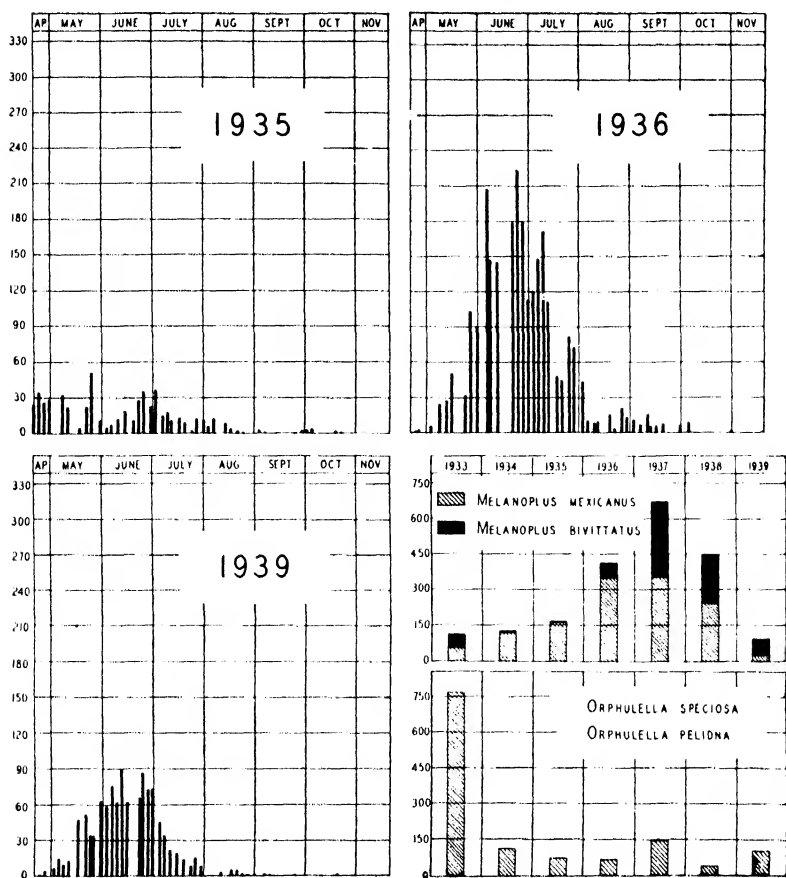


FIGURE I

Graphs showing numbers and seasonal distribution of acridian nymphs, 1933 to 1939 inclusive. At the lower right are graphs comparing collections of adults of *Melanoplus mexicanus* and *M. bivittatus* (above) with *Orphulella speciosa* and *O. pelidna* (below).

reasonable to postulate that excessively hot, dry summers might result in a physiological drouth, comparable to that which takes place during the winter. Many of the farmers of Kansas know that *M. mexicanus* oviposits in bare soil without the advantage of any cover. This bare soil frequently attains surface temperatures of 130° F. and may go up many additional degrees. Whatever the explanation, the hatch was dependent upon the September rains just as was the emergence of the Chloropidae from the same area (Wilbur and Sabin, 1936).

POPULATIONS OF ADULTS. During the seven years a total of 5,444 adults of 33 species were taken in collections (Table 4). Approximately 68 percent of the total collections were of four species. Sixteen of the species were represented by five or fewer specimens.

TABLE 4

Species and numbers of adult grasshoppers secured in the collection.

Species	Native prairie	Kentucky bluegrass	Orchard brome	Total
<i>Orphulella</i> spp.	1134	147	64	1345
<i>Ageneotettix</i> deorum	146	70	1091	1307
<i>Melanoplus</i> mexicanus	129	413	755	1297
<i>Melanoplus</i> bivittatus	58	153	530	741
<i>Mermiria</i> spp.	153	11	31	195
<i>Melanoplus</i> femur-rubrum	42	66	37	145
<i>Melanoplus</i> packardii	75	13	35	123
<i>Syrbula</i> admirabilis	14	39	2	55
<i>Pardalophora</i> haldemanii	11	22	13	46
<i>Hippiscus</i> rugosus	10	20	14	44
<i>Melanoplus</i> confusus	17	16	7	40
<i>Melanoplus</i> differentialis	4	10	25	39
<i>Hypochlora</i> alba	5	12	0	17
<i>Hesperotettix</i> v. viridis	13	2	0	15
<i>Opeia</i> obscura	3	1	1	5
<i>Phoetaliotes</i> nebrascensis	4	0	1	5
<i>Melanoplus</i> scudderi latus	4	0	0	4
<i>Trachyrhachis</i> k. kiowa	0	2	2	4
<i>Arphia</i> xanthoptera	3	0	0	3
<i>Hesperotettix</i> v. pratensis	2	1	0	3
<i>Eritettix</i> simplex	1	1	0	2
<i>Hesperotettix</i> speciosus	1	0	1	2
<i>Chortophaga</i> viridifasciata	0	2	0	2
<i>Aulocara</i> ellioti	0	0	2	2
<i>Arphia</i> simplex	1	0	0	1
<i>Arphia</i> pseudonietana	0	1	0	1
<i>Phlibostroma</i> quadrimaculatum	1	0	0	1
<i>Dissosteira</i> carolina	0	0	1	1
<i>Boopedon</i> maculatum	0	0	1	1
<i>Encoptolophus</i> sp.	0	0	1	1

HABITATS. The total number of species represented in the various grasslands was about equal, there being 26 species taken from the native grass pasture, 21 from the Kentucky bluegrass pasture, and 22 from the orchard-brome grass pasture. There was, however, a great diversity in the importance of the various species and groups of species in the different pastures as indicated in Table 5.

TABLE 5
Distribution by years of the important groups or species of grasshoppers according to habitat

	Total adults	Av. %	Percentage of total collections						
			1933	1934	1935	1936	1937	1938	1939
Native prairie	233	12.2	1.32	7.55	29.45	27.98	21.18	31.40	5.23
Ky. bluegrass	64	64.2	36.84	81.11	56.41	78.99	74.67	67.32	16.67
Orchard-brome	1347	51.6	33.54	32.54	60.00	49.09	38.82	88.48	85.42
Total	2222								
Native prairie	1287	70.2	95.11	55.35	38.36	40.93	47.06	36.05	79.74
Ky. bluegrass	158	15.8	38.84	8.89	28.20	13.45	5.59	12.68	27.78
Orchard-brome	95	3.6	6.96	14.29	8.65	3.13	2.31	0.28	5.21
Total	1540								
Native prairie	146	8.0	1.32	30.82	6.85	4.66	18.83	4.65	0.00
Ky. bluegrass	70	7.0	14.29	2.22	3.85	1.68	9.21	5.85	5.56
Orchard-brome	1091	41.4	46.84	48.41	22.70	45.96	57.95	0.84	2.08
Total	1307								
Native prairie	168	9.6	2.25	6.28	25.43	26.43	12.93	27.90	15.03
Ky. bluegrass	130	13.0	12.03	7.78	11.54	5.88	10.53	14.15	49.99
Orchard-brome	77	3.4	12.66	4.76	8.65	1.82	0.92	10.40	7.29
Total	375								

¹*Melanoplus mexicanus*, *M. bivittatus*, *M. femur-rubrum* and *M. differentialis*.²*Orphulella speciosa* and *O. pelidna*; *Mermiria maculipennis macclungi*, *M. neomexicana*, and *Mermiria bivittata*.

(Note—The 4 percentages in each column recorded for native prairie total 100 percent; the same is true for Kentucky bluegrass and orchard-brome).

Taking the collections for the entire period, the three most important species for the habitats observed were as follows:

Native prairie	Kentucky bluegrass	Orchard-brome
1. <i>Orphulella</i> spp.	1. <i>M. mexicanus</i>	1. <i>A. deorum</i>
2. <i>Mermiria</i> spp.	2. <i>M. bivittatus</i>	2. <i>M. mexicanus</i>
3. <i>A. deorum</i>	3. <i>Orphulella</i> spp.	3. <i>M. bivittatus</i>

For the individual years the importance of the species in the different habitats varied somewhat:

	Native prairie	Kentucky bluegrass	Orchard-brome
1933	1. <i>Orphulella</i> spp. 2. -----	1. <i>Orphulella</i> spp. 2. <i>M. mexicanus</i>	1. <i>A. deorum</i> 2. <i>M. bivittatus</i>
1934	1. <i>Orphulella</i> spp. 2. <i>A. deorum</i>	1. <i>M. mexicanus</i> 2. <i>Orphulella</i> spp.	1. <i>A. deorum</i> 2. <i>M. mexicanus</i>
1935	1. <i>Orphulella</i> spp. 2. <i>M. mexicanus</i>	1. <i>M. mexicanus</i> 2. <i>Orphulella</i> spp.	1. <i>M. mexicanus</i> 2. <i>A. deorum</i>
1936	1. <i>Orphulella</i> spp. 2. <i>Mermiria</i> spp.	1. <i>M. mexicanus</i> 2. <i>M. bivittatus</i>	1. <i>A. deorum</i> 2. <i>M. mexicanus</i>
1937	1. <i>Orphulella</i> spp. 2. <i>Mermiria</i> spp.	1. <i>M. mexicanus</i> 2. <i>M. bivittatus</i>	1. <i>A. deorum</i> 2. <i>M. bivittatus</i>
1938	1. <i>Orphulella</i> spp. 2. <i>Mermiria</i> spp.	1. <i>M. mexicanus</i> 2. <i>M. bivittatus</i>	1. <i>M. mexicanus</i> 2. <i>M. bivittatus</i>
1939	1. <i>Orphulella</i> spp. 2. <i>Mermiria</i> spp.	1. <i>S. admirabilis</i> 2. <i>Orphulella</i> spp.	1. <i>M. bivittatus</i> 2. <i>M. mexicanus</i>

During the more severe of the drouth years the crop infesting *Melanopli* assumed the dominance in numbers. The rise of *Melanoplus mexicanus* and *M. bivittatus* and the decline of *Orphulella* spp. is indicated in the graphs in the lower righthand corner of Figure I. In the native prairie the *Melanopli* rose from 1 percent to a high of 31 percent of the population and then dropped back to 5 percent. A similar situation occurred in Kentucky bluegrass with the *Melanopli* starting at 36 percent of the hopper population of 1933, then jumping to 81 percent and retaining a high level until 1939 when it dropped to 16 percent. The high percentage of *Melanopli* in the orchard-brome pasture in 1938 and 1939 is undoubtedly due to the substitution of a young stand of grass for the established stand previously collected. The same explanation explains the extreme drop in populations of *A. deorum* for the same years. *Orphulella* maintained its dominance in the native prairie during each of the seven years. Its numbers however were greatly reduced after 1933.

INDIVIDUAL SPECIES

ORPHULELLA spp. This refers chiefly to *O. speciosa*, altho it is probable that a few species of *O. pelidna* may likewise have been present. Adults of *Orphulella* were first taken in late June or early July and disappeared almost uniformly after the first week in September. The peak of abundance normally occurred from July 15 until August 15, altho in 1934, the peak was two to three weeks early. Of the 1,345 specimens taken during the seven years, 57 percent were males and 43 percent females. *Orphulella speciosa* more definitely characterized the bluestem grasslands in this region than any other grasshopper with the possible exception of *Memiria maculipennis macclungi*. Eighty-four percent of the total specimens were from the native prairie while only 11 percent were from Kentucky bluegrass and 5 percent from orchard-brome grasses. This percentage varied from year to year however. In 1938, the year of fewest specimens, only 41 percent were from the native grasses while during 1933, the year of greatest abundance, over 92 percent were swept from native grasslands.

AGENEOTETRIX DEORUM. This species was taken in greater numbers in the collections than any other species except *Orphulella speciosa*. It was predominantly found on the cultivated pasture of orchard-brome grasses. Of a total of 1,307 specimens, 84 percent were from orchard-brome, 11 percent from native prairie and 5 percent from Kentucky bluegrass. The species built up from a low ebb in 1933 to a high peak in 1937. At this time the orchard-brome pasture under observation was plowed and the observations were transferred to a new orchard-brome planting across the road. During the collections of 1938 and 1939 a maximum of 3 specimens per collection was taken from the young orchard-brome pasture. Approximately 53 percent of all the specimens were males and 47 percent were females.

The earliest adults appeared in the collection between June 19 and July 12 and disappeared about the last week in September or the first in October. The peak of abundance occurred through July into August. In 1937 the peak was maintained until September 9.

MELANOPLUS MEXICANUS. This grasshopper had the dubious honor of being the most injurious crop infesting species in this region during the recent outbreak. Normally *mexicanus* is not abundant in good grasslands in the bluestem prairie area. However, during the drouth years it was able to build up large populations in both the Kentucky bluegrass and the orchard-brome grass pastures, more particularly the latter. Less than 10 percent of a total collection of 1,297 specimens was taken from native prairie grasses.

This species was one of the earliest grasshoppers to appear in the spring in the adult stage and it held on until the heavy frosts

came in the fall. The peak of abundance extended from the middle of June until late July. In 1934 there was a noticeable fall peak of adults between October 6 and November 9. Of all the specimens taken, 54 percent were males and 46 percent females.

MELANOPLUS BIVITTATUS. This species was the second most abundant *Melanoplus* found in the pastures. During the 7 years, there was a total collection of 741 adults of *M. bivittatus*, 71 percent of which came from the orchard-brome pasture, 21 percent from the Kentucky bluegrass and 8 percent from native prairie. The years of peak of infestation were 1937 and 1938 while during 1934 and 1935 the species was almost non-existent in our grasslands. The specimens taken were 51 percent males and 49 percent females. Adults of *M. bivittatus* usually appeared by the middle of June shortly after those of *M. mexicanus*. They did not last until frosts as *M. mexicanus* did but disappeared during September or early October.

MERMIRIA spp. These consist chiefly of *M. maculipennis macclungi* with a lesser number of *M. neomexicana* and a few of *M. bivittata*. Like *Orphulella*, *Mermiria* spp. are typical of the bluestem prairie. Of a total of 194 specimens 78 percent were from the native prairie, 6 percent from Kentucky bluegrass and 16 percent from orchard-brome grass. During the 1939 season this species was so abundant in various native grass pastures in this region that it reached outbreak proportions. Approximately 60 percent of the specimens collected were males and 40 percent were females. For the most part the adults appeared during the first half of July and disappeared during September and early October.

MELANOPLUS FEMUR-RUBRUM. This species was more evenly distributed over the three pastures than were any of the other species. Of the 145 specimens collected, 28 percent were from native prairie, 46 percent from Kentucky bluegrass and 26 percent from orchard-brome. Most of the specimens were taken during 1935, 1936, 1937 and 1938. While our records show that 49 percent of the adults were males and 51 percent females, any identification of females of *M. mexicanus*, *M. femur-rubrum* and *M. confusus* may be erroneous. The adults made their first appearance about the middle of June, with occasional specimens in late May. By October most of them were gone.

MELANOPLUS PACKARDII. This species is frequently found attacking crops during outbreak years but it is primarily an inhabitant of the native grasslands, particularly dry upland prairies. Of the 125 specimens taken, 60 percent were from the native prairie, 10 percent from Kentucky bluegrass and 30 percent from orchard-brome. The largest collections were made in 1935 through 1938. This species almost disappeared during 1939. The first adults usually appeared during late June or early July, but in 1936 one was taken on May 26.

The last specimens were collected during late August or September

SYRBULA ADMIRABILIS. This beautiful grasshopper species is frequently found in large numbers during late summer and early fall in the grasslands of this region. During the 1939 season it was present along with *Mermiria* in outbreak numbers in certain native grass pastures.

MELANOPLUS DIFFERENTIALIS. This species was one of the most injurious grasshoppers to crops in this region during the 1935, 1936, and 1937 seasons. The small numbers taken from the three pasture areas, however, indicate that it is not primarily an inhabitant of grasslands. During the 7 years of observations only 39 specimens were taken and these were mostly from the orchard-brome pasture. This grasshopper was actually present in the grasslands in greater abundance than the numbers indicate. Because of its alertness, it more easily evaded the net than most other species.

SUMMARY

1. A survey of the literature on Orthoptera reveals that several studies have been made of the grasshoppers inhabiting the grasslands of the Central and Southern Prairie states. The general results of these studies indicate that the grasshopper populations of the native prairie are characterized by the genera *Orphulella* and *Mermiria* while the genus most typical of the croplands and the weed patches is *Melanoplus*.

2. Collections were made thruout the growing season of the years 1933 thru 1939 on three representative pasture types; native prairie, Kentucky bluegrass, and orchard-brome pasture at the Kansas Agricultural Experiment Station.

3. The weather at Manhattan (1933-1939) constituted the hottest and most severe period of drouth on record for Kansas. There was a rainfall deficiency of 43.33 inches below that expected on the basis of a 53-year average. The temperature on 260 days of the collecting period reached 100° F. or more.

4. Nearly 14,000 grasshopper nymphs were secured in the collections, the largest number being taken in 1933 and the fewest in 1935. The grasshopper population of the native prairie was much greater than that in the Kentucky bluegrass and in the orchard-brome grass pastures in 1933 and 1934, but during 1936 thru 1938 the situation was reversed. The meadow grasshoppers were practically eliminated from the collections after 1933 until 1939. Large partial second generations of *Melanoplus mexicanus* occurred in 1934 and 1937.

5. Thirty-three species of adult grasshoppers totaling 5,444 specimens were taken during the collections. Approximately 68 percent of the adults collected were of four species while 16 of the species were represented by five or fewer specimens.

6. The studies confirmed the observations of others that the genera *Orphulella* and *Mermiria* dominate the grasshoppers in the native prairie. They also indicate that the crop-infesting species of the genus *Melanoplus* together with *Ageneotettis deorum* dominate Kentucky bluegrass and orchard-brome grass pastures.

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CONTENTS OF THIS NUMBER

The Ninth Annual Insect Population Summary of Kansas— 1939. Roger C. Smith and E. G. Kelly	65
Grasshopper Populations (Orthoptera, Acrididae) of Typical Pastures in the Bluestem Region of Kansas. Donald A. Wilbur and Roy F. Fritz	86

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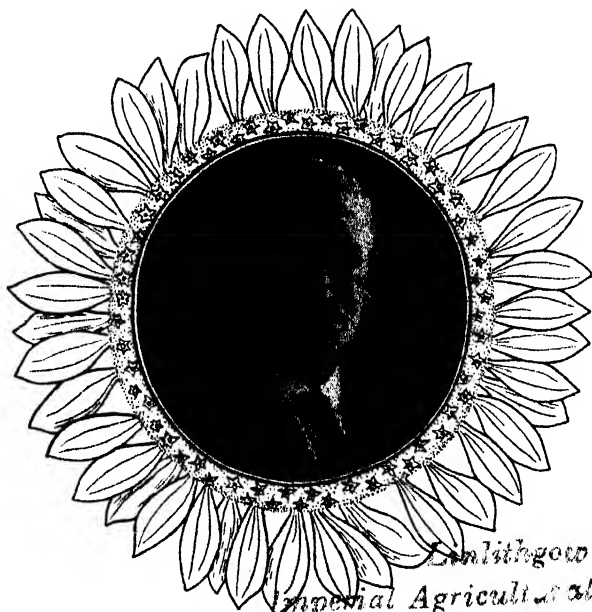
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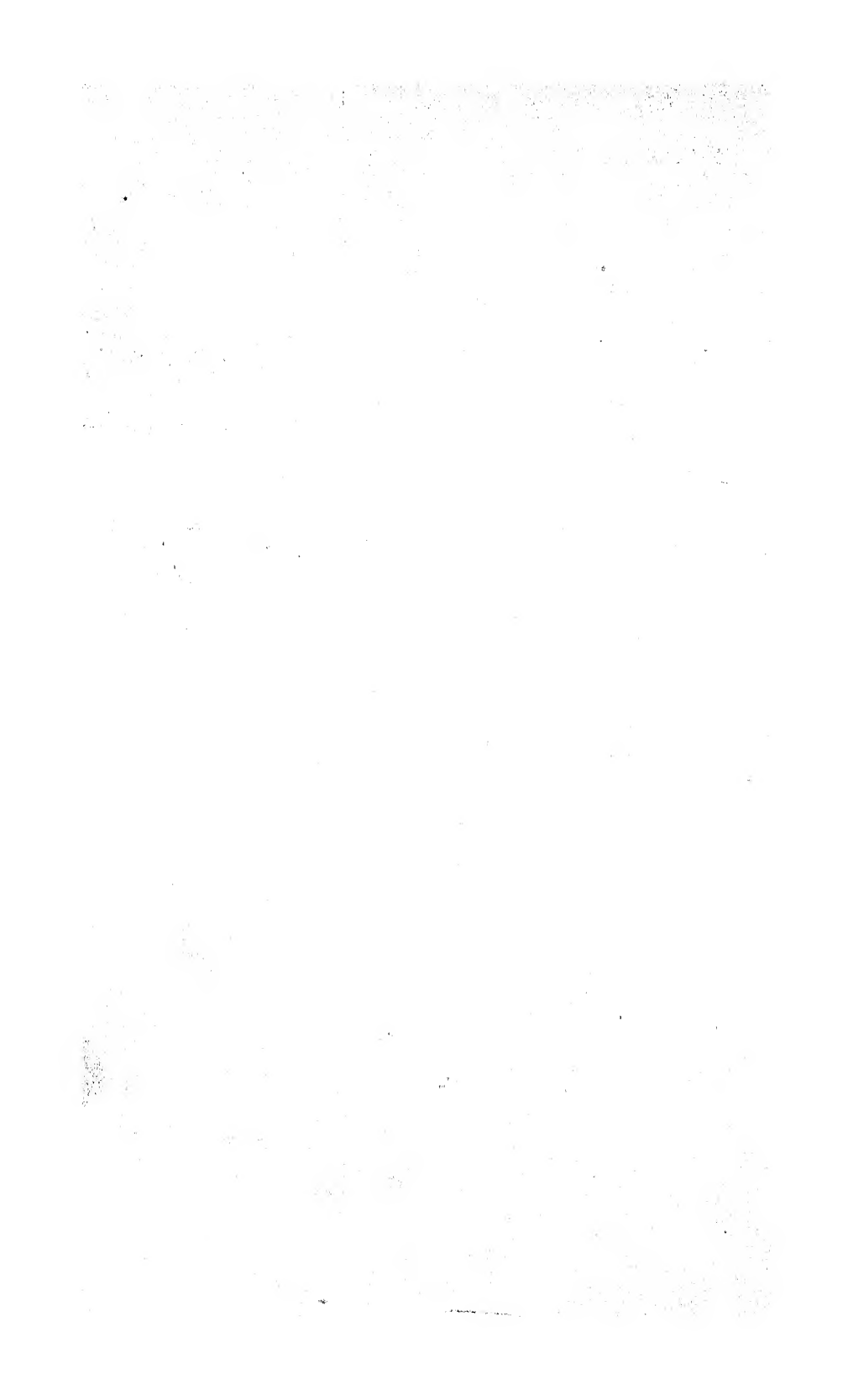


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DORYLAIDAE NOTES AND DESCRIPTIONS (PIPUNCULIDAE-DIPTERA)

D. Elmo Hardy, Lawrence, Kansas*

The new species discussed in this paper have been encountered while making a comparative study of the male genitala throughout the family *Dorylaidae*. These structures have proved especially important in the taxonomy of the genus *Tömösváryella*. Most of the specimens included in this study were taken by the Snow Entomological Expedition, under the direction of Dr. R. H. Beamer, the summer of 1939 and unless otherwise specified the types are in the Snow Entomological Collection, University of Kansas.

A very recent development in the genus *Tömösváryella* has brought to light two of the new synonyms which are recorded here. The writer is greatly indebted to Dr. Marton Aczél of the Royal Hungarian Institute for Plant Protection for his energetic cooperation in studying the type of *coquilletti* and for presenting compared specimens of this species, as well as *sylvatica* (Meigen), for study. The writer had requested that the type of *coquilletti* (Kertész) be examined in an attempt to place it properly, Dr. Aczél made careful drawings of the type of this species and of *sylvatica* (which Kertész allied to *coquilletti*); study of the compared specimens proved the following synonymy without question.

Tömösváryella coquilletti (Kertész)

Pipunculus coquilletti Kertész, 1907, Annales Muséi Nationalis Hungarici, v, 582-583.

Pipunculus proximus Cresson, 1911, Trans. Am. Ent. Soc. XXXVI, 318-319. New synonymy.

This is a very common and wide spread species in America and is also found in at least parts of Europe. Dr. Aczél discovered that specimens from Hungary, which he had considered as a new species, were the same as *coquilletti* and the compared Hungarian specimens presented were identical with homotypic specimens of *proximus*.

Tömösváryella sylvatica (Meigen)

Pipunculus sylvaticus Meigen, 1824, System. Besch. der Bekannten Europ. Zweifl. Ins. IV, 20.

Pipunculus scoparius Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 317. New synonymy. Specimens of *sylvatica* sent from Hungary by Dr. Aczél proved identical with homotypic specimens of *scoparius*.

*Contribution from Department of Entomology, University of Kansas.

Dorylas ater (Meigen)

Pipunculus ater Meigen, 1824, System. Besch. der Bekannten Europ. Zweifl. Ins. IV, 23.

Pipunculus cingulatus Loew, 1865, Centuria VI. Berl. Ent. Zeit., IX, 176. New synonymy. Specimens of **ater** from Germany have been compared with the type male of **cingulatus**, no. 453, in the Cambridge Museum of Comparative Zoology and found to be conspecific with it.

Pipunculus fuscus Cresson (nec Loew), 1911, Trans. Amer. Ent. Soc. XXXVI, 301. New synonymy. The species described by Cresson as **fuscus** Loew was actually the species which Loew described as **cingulatus**.

Pipunculus horvathi Kertész, 1907, Ann. Musei Nationalis Hungarici, V, 579-580. New synonymy. Association of the sexes has proved this to be the female of **ater** Meigen (**cingulatus** Loew), the two sexes are not dimorphic except that the female abdomen is more consistently shining on the dorsum. The sexes have long been considered two distinct species but all doubt of their association was removed when the writer took them in copulation.

Pipunculus townsendi Malloch, 1913, Proc. U. S. Nat. Mus, 43, 292. New synonymy. Homotypic specimens compared with Loew's type of **cingulatus** proved them to be conspecific.

Dorylas kansensis n. sp.

(Plate 1, Figs. 1a-1e)

This species is related to **affinis** (Cresson), and because of the structural (aside from genital) similarity the writer had considered it just a subspecies until the male genitalia were studied. These structures present ample evidence of its specific rank.

The species differs from **affinis** in being more melanistic; having the third antennal segment shorter, subacuminate below (fig. 1a); thorax and abdomen subshining, lightly dusted with gray, abdominal segments without distinct cinereous vittae, fifth segment scarcely longer than the fourth; third section of the costa is slightly shorter than the fourth and the ultimate section of fourth vein (M_{1+2}) strongly sinuate (fig. 1e.). The upper one-half of the front in the females is shining black and the ovipositor is slightly longer than in **affinis**, extending to the base of the third abdominal segment (fig. 1b).

The male genitalis of **affinis** and **kansensis** are nearly identical from dorsal view, being symmetrical without marked depression apically. The hypopygium is more nearly equal the length of the fifth abdominal tergum in **kansensis**, due to the shortness of that sclerite (fig. 1c). From a ventral view the genitalia is very distinctive, the ninth segment is about as wide as long with a deep U-shaped

cleft in middle on apical margin, the cleft extends about three-fourths the length of the segment on a median line. The harpagones are broad, bluntly pointed, strongly sclerotized and dark in color; the inner clasper is the wider and very slightly longer than the outer (fig. 1d). The membranous portion is on the apex of the eighth on the right. The seventh sclerite is about the same width as the base of the inner clasper; the sixth segment is reduced to a narrow strip and curves under the claspers giving support to the wall of the genital chamber.

Length male: body 3.6-3.8 mm.; wings, 4-4.1 mm.

Length female: body, 3.5 mm.; wings, 4mm.

Holotype male: Douglas County, Aug. 27, 1939 (R. H. Beamer); allotype, female and twenty-six paratypes (thirteen males, thirteen females) same locality and collector, Aug. 23-27, 1939. Five paratype males, Tokio, North Dakota 7-28-1937 (C. L. Johnston); three males, four females, Tonganoxie, Kansas, May 6, 1939 (D. E. Hardy); one male, one female, Barberton, Ohio, 8-10-1936 (L. J. Lipovsky); three males, three females, Cherokee Co., Kansas 8-30-1939 (R. H. Beamer); two females, Garnett Co., Kansas, 8-29-1939 (R. H. Beamer) and one female, Logan Canyon, Utah, July 26, 1939, (W. P. Nye, G. S. Stains).

One paratype returned to Utah State Agricultural College.

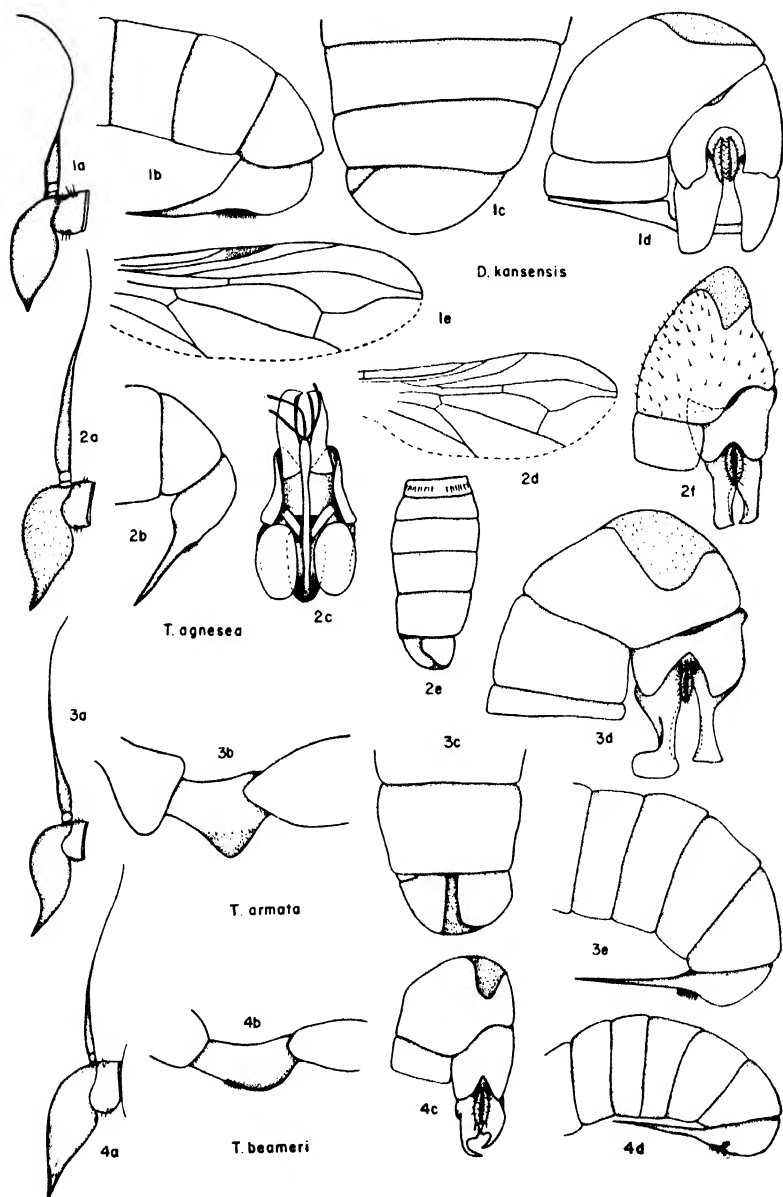
Tömösváryella agnesea n. sp.

Plate 1, (Figs. 2a-2f)

This is a common mid-western species related to *similis* (Hough) but differing in wing venation and genital characters. The r-m crossvein is situated beyond the middle of the discal cell; the ninth segment is broadly U-shaped on hind margin and the claspers of the male are more broad, square tipped and blunt, the eighth segment is also longer and more pointed; larger, more robust and distinctly pollinose species.

Male—Head: Frontal triangle silvery, darker in the middle, upper portion of front shining black; third antennal segment acuminate (fig 2a), brown to black in ground color, densely white pubescent; mouthparts yellowish. Compound eyes joined for less than one-third the length of the frontal triangle. **Thorax and abdomen:** Metallic black in ground color but rather densely gray pollinose and more thickly haired than in *similis*. Humeri and halteres bright yellow. Legs colored as in *similis*, front femora with a pair of flexor bristles near bases; mid-coxae with two to three long bristles at their apices; hind trochanters each with a clump of stout short hairs below, these are more numerous but not so long and thin as in *similis*. Femora moderately thickened, spines very weak; tibiae almost straight; hind tarsi flattened and dilated. **Wings:** very faintly iridescent, third section of costa about one-half the length of the

PLATE I



fourth; fifth section almost twice as long as third and fourth combined. Crossvein r-m situated about half way between the ends of veins R_1 and R_{2+3} and beyond the middle of the discal cell; last section of fourth vein sinuate (fig. 2d). Sides of abdomen almost straight, widest at second and third segments; fifth segment but little longer than the fourth. **Hypopygium:** About three-fourth the length of the fifth segment, scarcely compressed to the right, with a large apical depressed area; the longitudinal groove lies slightly to the left due to the longer overfolding of the eighth segment on the right side (fig. 2e). From ventral view, in a relaxed condition, the hypopygium is usually quite acutely pointed due to the expansion of the membranous areas at the apex. The ninth sclerite is about as broad as long, with a broadly U-shaped concavity on the hind margin, cleft less than one-fourth its length. Harpagones broad and flat, rather square tipped and but slightly hollowed out on the inner margins below (fig. 2f). Aedeagus with two large basal supporting plates attached to ninth sclerite by apodemes (fig. 2c).

Length: body, 3 mm.; wings, 2.7 mm.

Female: The females are for the most part inseparable from *similis* unless accompanied by the males. The upper one-third of the front is shining black; the r-m crossvein is situated at or beyond the middle of the discal cell; the ultimate section of the fourth vein is slightly curved instead of straight, as in *similis* and the body is more pollinose. Posterior tarsi flattened and somewhat swollen, first tarsal subsegment almost equal to the remaining four. Base of ovipositor subglobose, shining black, piercer scarcely longer than base (fig. 2b) and extending just beyond apex of third segment.

Holotype male, Lawrence, Kansas, Aug. 22, 1939 (Agnes T. Hardy); allotype female same data. Paratypes: thirteen males, eleven females, same locality as holotype, Aug. 22-27, 1939 (R. H. Beamer, A. T. Hardy, D. E. Hardy, G. H. Vansell); six males, three females, Manhattan, Kansas, July 9-Nov. 6, 1934-1937, D. A. Wilbur); two

EXPLANATION OF PLATE 1

Fig. 1. *Dorylas kansensis* n. sp.

a. antenna; b. female abdomen, lateral view; c. male abdomen, dorsal view; d. male genitalia, ventral view; e. wing.

Fig. 2. *Tömösváryella agnesea* n. sp.

a. antenna; b. female ovipositor, lateral; c. male genitalia, dorsal view with eighth segment removed; d. wing; e. male hypopygium, ventral view.

Fig. 3. *Tömösváryella armata* n. sp.

a. antenna; b. hind trochanter of male; c. male hypopygium, dorsal view; d. male hypopygium, ventral; e. female abdomen, lateral.

Fig. 4. *Tömösváryella beameri* n. sp.

a. antenna; b. hind trochanter of male; c. male hypopygium, ventral; d. female abdomen, lateral.

males, Cherokee County, Kansas, April 20, 1935, Aug. 30, 1939 (R. H. Beamer); one male, Garnett, Kansas, Aug. 29, 1939 (J. D. Beamer); one male, Coconino County, Arizona, Aug. 18, 1927 (R. H. Beamer); one male, Oak Creek Canyon, Arizona, 6000 ft., Aug. (F. H. Snow); one male, Eagle Pass, Texas, 1-29-33 and thirteen males, three females, Sioux City, Iowa, July 11-Aug. 24, 1931 (C. N. Ainslie).

Paratypes are being returned to Kansas State College; University of Minnesota and Texas A. and M. College.

***Tömösváryella armata* n. sp.**

(Plate 1, Figs 3a-3e)

This species belongs to the *vagabunda* group by having the hind trochanters of the male armed with tubercles; the shape of these developments and the male genital characters will distinguish it from all other species.

Male: Rather sparsely haired species, dorsocentral hairs present and also scattered marginal hairs on mesonotum, scutellum and abdomen. **Head:** Face and frontal triangle silvery, the latter slightly darker; front shining black above junction of eyes; eyes joined for more than half the length of the frontal triangle. Antennae black, third segment acuminate (fig. 3a). **Thorax and abdomen** subshining black in ground color rather densely brownish pollinose; grayed on the margins, pleurae and metanotum. **Legs:** Femora moderately thickened, flexor spines weak; front femora with one or two rather weak flexor bristles near bases, middle coxae with three to four moderately strong black apical bristles. Hind trochanters comparatively short in length, each with a distinct obtuse carina or tubercle just beyond the middle below (fig. 3b); this tubercle is thickly covered with microscopic white pile. Hind tibiae slightly curved, tarsi flattened; basitarsi longer than the next three subsegments. **Wings:** Very lightly iridescent, third costal section about half the length of the fourth; fifth section about twice the length of third and fourth sections combined. Crossvein r-m situated much beyond the end of vein R_1 and at middle of discal cell; ultimate section of fourth vein about straight; last section of fifth shorter than posterior crossvein. Sides of abdomen somewhat rounding, fifth segment about one-third longer than fourth. **Hypopygium:** Rather symmetrical, broadly rounding, about three-fourths the length of the fifth segment, only slightly compressed to the right with a broad longitudinal groove medianly and a distinct apical depression (fig. 3c). Ninth segment about as broad as long, with a V-shaped cleft apically about three-fourths of its length on median line. Harpagones asymmetrical, inner clasper greatly enlarged at apex with a large rounding lobe on right side, from ventral view; outer clasper en-

larged at apex but not so developed (fig. 3d).

Length: body, 3 mm.; wings, 2.8 mm.

Females: The females associated here have the upper one-third of the front shining with a narrow black stripe extending down into the silvery area; the hind trochanters are unarmed except for a few pale hairs below; the tarsi are more flattened and dilated. The base of the ovipositor is globose, the piercer about twice its length and gradually tapering at base (fig. 3e); piercer extending to apex of second abdominal segment.

Holotype male, Griffin, Ga., Aug. 12, 1939 (J. D. Beamer); allotype female and one paratype female same data; one paratype male, Okefenokee Swamp, Ga., July 27, 1939 (A. T. Hardy) and three paratypes, one male, two females, Billy's Island, Okefenokee Swamp, Ga., July 1912 (Cornell University Expedition).

Two paratypes being returned to Cornell University.

***Tömösváryella beameri* n. sp.**

(Plate 1 figs. 4a-4d)

This species is related to *similis* (Hough) but the male genitalia is very distinctive. The specimens are also smaller in size.

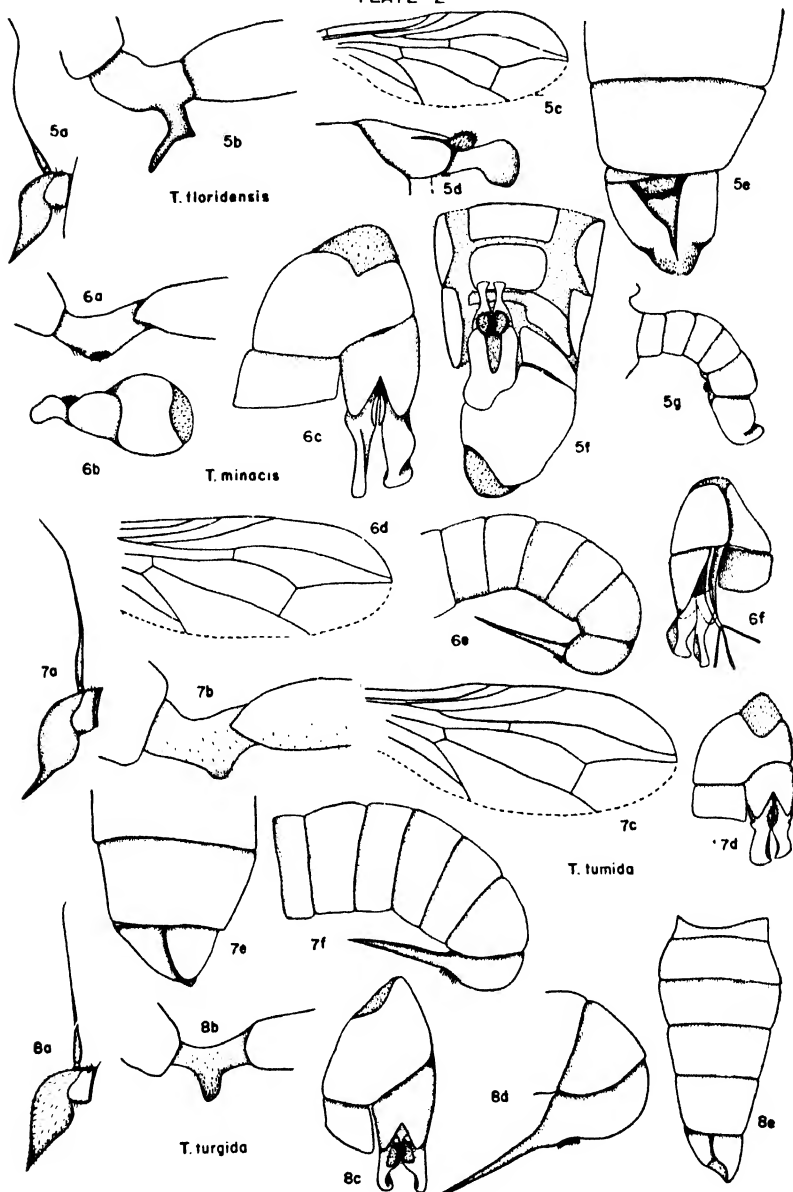
Male: Fitting the description of *similis* in most details. The eyes are joined for less than one-third of the length of the frontal triangle and the front is silvery above the junction of the eyes. The thorax and abdomen are more distinctly pollinose and more thickly haired. The dorsocentral hairs rather strong. Posterior trochanter with just a few inconspicuous short hairs, and distinctly carinated beneath (fig. 4b). Posterior basitarsi longer than next four tarsal subsegments; hind tarsi flattened. Wings more hyaline, very slightly milky. Hypopygium like *similis* in dorsal view, from ventral view the ninth segment is much longer than wide, equaling the eighth in length, with a V-shaped cleft on apical margin, extending over one-third its length. Harpagones very irregular, almost symmetrical, with their posterior lateral margins strongly produced into a pair of sharply pointed, incurving lobes (fig. 4c); inner clasper slightly longer than the outer.

Length: body 2 1-2-3 mm.; wings, 2.2 mm.

Female: Differs from *similis* in having the piercer of the ovipositor about twice as long as base (fig. 4d) and extending beyond the apex of the second segment. The posterior basitarsi are short and very flat, scarcely as long as the next three tarsal subsegments in length.

Holotype male, Douglas County, Kansas, Aug. 23, 1939 (R. H. Beamer); allotype female, same locality, Aug. 23, 1939 (D. E. Hardy). Paratypes; two males, one female, same data Aug. 22-23, 1939 (R. H. Beamer, A. T. Hardy, D. E. Hardy); six males, three females, Cherokee County, Kansas, Aug. 30, 1939 (R. H. Beamer).

PLATE 2



Tömösváryella floridensis n. sp.

(Plate 2, Figs. 5a-5g)

This species is related to *toxodentis* (Hardy-Knowlton), the two are readily separated by comparing the tooth-like developments of the posterior trochanters and the male hypopygia.

Male: Almost entirely black, sparsely pilose species. **Head:** Antennae yellow-brown to brown, third segment long acuminate (fig. 5a), first two sections of the arista pale. Eyes joined on upper portion of front for about one-half the length of the frontal triangle. Face silvery pubescent; front, below the junction of the compound eyes, faintly gray to silvery; upper portion of front and vertex shining black. Occiput subshining, only faintly gray dusted above, cinereous on the sides and lower portion; posterior margin of eyes slightly indented on upper half so that the portion of the occiput above is more swollen. **Thorax and abdomen:** Shining metallic black in ground color, very faintly dusted; pleurae and metanotum more grayish, sternopleurae shining on lower portions, humeri and halteres bright yellow. Legs chiefly black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow. Femora moderately thickened, with two rows of strong spines on apical halves below; anterior femora each with two long flexor bristles near bases below; middle coxae with a transverse row of long slender, downward directed bristles at their apices, above. Posterior trochanters each with a distinctively shaped tooth-like projection on under sides near apices; this tooth directs downward for about half its length then abruptly narrows and slants towards the base of the trochanter (fig. 5b). Tibiae almost straight, only slightly bowed; basitarsi equal in length to the next three tarsal subsegments. **Wings:** Hyaline very faintly iridescent, third section of costa little less than one-half the length of the fourth; fifth costal section twice as long as third and fourth combined. Crossvein r-m situated at or slightly

EXPLANATION OF PLATE 2

Fig. 5. *Tömösváryella floridensis* n. sp.

a. antenna; b. hind trochanter of male; c. wing; d. ninth segment and harpagone, lateral view; e. male hypopygium, dorsal; f. posterior portion of male abdomen, ventral; g. male abdomen, lateral.

Fig. 6. *Tömösváryella minacis* n. sp.

a. hind trochanter of male; b. male hypopygium, lateral; c. male hypopygium, ventral; d. wing; e. female abdomen, lateral; f. male hypopygium, dorsal view with abdomen dissected away.

Fig. 7. *Tömösváryella tumida* n. sp.

a. antenna; b. hind trochanter of male; c. wing; d. male hypopygium, ventral; e. male hypopygium, dorsal; f. female abdomen, lateral.

Fig. 8. *Tömösváryella turgida* n. sp.

a. antenna; b. hind trochanter of male; c. male hypopygium, ventral; n. female ovipositor, lateral; e. male abdomen, dorsal.

beyond the end of vein R1 and just before the middle of the discal cell. Last section of fourth vein (M_{1+2}) slightly curved, longer than the third section of that vein (from r-m crossvein to m-cu); posterior crossvein (m-cu) longer than last section of the fifth vein (cu_1) (fig 5c). **Abdomen:** Sides but gently rounding, widest at segments two to four; the posterior portion of the abdomen is strongly bent downward. Fifth abdominal segment longer than the fourth, hypopygium about equal to the fifth in length. **Hypopygium** With a distinct vertical keel at apex, above (fig. 5g) and a large median cleft area extending from the base almost to the keel from dorsal view (fig 5e). The apical portion of the hypopygium is less heavily sclerotized and densely covered with short microscopic setae; this area seems to be formed by an out folding of the eighth segment. From ventral view the ninth segment is deeply cleft, the cerci are large and rounding and the harpagones rather narrow and enlarged at their tips (fig 5f); from lateral view it is seen that the claspers are very flat, enlarged and rounding apically (fig 5d); harpagones yellowish in color.

Length: body, 2.6-2.9 mm.; wings, 2.6 mm,

Female: The association of the females is not at all certain, the specimens apparently belonging to this species run to *toxodentis* (Hardy-Knowlton) and cannot be conveniently separated from that species by structural characters. The third antennal segment is yellowish instead of black and the bristles of the middle coxae are stronger and black, being bright yellow in *toxodentis*. The front of the female is entirely silvery and sunken between the eyes; base of ovipositor rather rounding, piercer much longer than base and very slender, reaching to about the middle of the third abdominal segment.

Holotype male, Hilliard, Florida, Aug. 6, 1939 (D. E. Hardy); allotype female and four paratypes, 3 males, 1 female, same data as holotype; one paratype male, one female, Adel, Ga., Aug. 11, 1939 (D. E. Hardy-J. D. Beamer); one paratype male, Okefenokee Swamp, Ga., Aug. 1, 1939 (A. Hardy); and one paratype male, Honey Island, Okefenokee Swamp, Ga., June 1, 1912, (Cornell Univ. Expedition.) One paratype being returned to Cornell University.

Tömösváryella minacis n. sp.

(Plate 2, Fig. 6a-6f)

This species is related to *similis* (Hough) but is readily separated by the development of the male clasping structures; the strongly carinated area on the dorsum of the outer clasper, the smaller carina of the inner and the broadened apices of these structures will distinguish it; the r-m crossvein is also situated at or slightly beyond the middle of the discal cell, instead of before the middle as in *similis*.

Male:—Head: First two segments of antennae black, bristles of

second segment short; third segment acuminate, like *similis* in shape, brownish in ground color, densely white pubescent. Face silvery, frontal triangle silvery with a light golden tinge, upper portion of front, above junction of eyes, and vertex shining black; upper portion of occiput subshining, sides silvery. **Thorax:** Shining in ground color, brownish dusted on dorsum of mesonotum and scutellum, rather lightly grayed on margins of mesonotum, distinctly gray pollinose on metanotum and upper portions of pleurae. **Legs:** For the most part, as in *similis*, the bristles of the mid-coxae are strong and yellowish to brown in color; the hind trochanters possess three to four small but distinctly visible hairs on under side near their bases and a medio-ventral patch of dense microscopic pile; this patch is located on a slightly raised area (fig. 6a), this is not distinctly tuberculate as in the *vagabunda* group. **Wings:** Lightly iridescent, third section of costa about one-half the length of the fourth; fifth section not quite twice the length of the third and fourth combined. Crossvein r-m situated well beyond the end of vein R_1 and slightly beyond the middle of discal cell. Ultimate section of fourth vein straight or nearly so, last section of the fifth about equal to the posterior crossvein in length (fig. 6d). **Abdomen:** Chiefly shining, only lightly dusted, sides but slightly rounding; fifth segment one and one-third times as long as the fourth. **Hypopygium:** About three-fourths the length of the fifth segment of abdomen, the longitudinal groove located just to the left of the median line, membranous apex plainly visible and sometimes extruded. The claspers are developed dorsally into strong carinae, more pronounced on the outer clasper (figs. 6b, 6c, and 6f), both claspers are bluntly pointed, the inner one is more slender and larger of the two and is scarcely curved inward at its apex; the outer is more stout and gently curved inwards at its apex; neither clasper is concave on the inner margin as in *similis*.

Length: body, 2.6 mm.; wings 2.6 mm.

Female: Differs in having the third antennal segment distinctly yellow, the front is silvery pollinose to the vertex, wider and distinctly concave in the middle. Crossvein r-m is situated at end of vein R_1 and distinctly before the middle of discal cell. Flexor spines of femora more developed, hind tibiae dilated on apical halves and tarsi more flattened. Base of ovipositor short and round, piercer slender, twice as long as base (fig. 6e), reaching to apex of second abdominal segment.

Length: body and wings, 2 mm.

Holotype male, Key Largo, Florida, July 10, 1939 (A. T. Hardy); allotype female, same data; paratypes: three males, Hilliard, Florida, July 24, 1939 (D. E. Hardy); Plant City, Florida, Aug. 15, 1930

(J. Nottingham) and Griffin, Ga., Aug. 12, 1939 (R. H. Beamer),

The holotype and allotype were collected in roadside grasses, *Deltocephalus flavicosta* was the most common leafhopper taken.

Tömösváryella tumida n. sp.

(Plate 2, Figs. 7a-7f)

This species is related to *Vagabunda* but is readily separated by the male genital structures.

Male: Head: First two segments of antennae brown to black, third segment brown, with a distinct yellow tinge in ground color and terminating in a slender acuminate point below (fig. 7a). Face silvery, frontal triangle golden; front, above junction of eyes, black. Eyes joined for less than one-half the length of the frontal triangle. **Thorax:** Metallic black in ground color, dusted with brown on the dorsum, faintly grayish on the upper portions of the pleurae, metanotum and margins of mesonotum; dorsocentral hairs weak. Legs chiefly black, narrow apices of femora and tibiae, broad bases of tibiae and first four tarsal subsegments yellow, apical subsegments of tarsi brown. Femora rather slender, spines very weak; front femora each with two small flexor bristles near bases; middle coxae with three to four strong apical bristles; hind trochanters with a distinct mound-like development on the under sides near apices (fig. 7b), this is fringed with dense white pile. Hind tarsi almost straight, with just a slight curvature; tarsi slightly flattened, basitarsi about equal to the next four tarsal subsegments in length. **Wings:** Distinctly infuscated and iridescent, third section of costa less than one-half the length of the fourth; fifth section about equal to the third and fourth combined. Crossvein r-m situated at the end of vein R₁ and well before the middle of the discal cell. Ultimate section of fourth vein almost straight, last section of fifth vein about equal to posterior crossvein in length (figs. 7c). **Abdomen:** Polished black only very faintly dusted on the dorsum, the ground color scarcely obscured; rather short, but little longer than the thorax, the sides gently rounding, widest at segment three. **Hypopygium:** Slightly compressed to the right, the longitudinal groove is just to the left of a median line, the membranous apex is distinct and slightly protruded; hypopygium about three-fourths the length of the fifth segment (fig. 7e). From ventral view the ninth segment is but little longer than wide, with a deep V-shaped cleft for almost half its length on posterior margin. Harpagones broad and strongly developed, asymmetrical, the inner clasper being the larger of the two; these are rather acutely pointed on inner apices, distinctly concave on inner margins and each with a pronounced notch near bases on outer margins (fig. 7d).

Length: body, 2.5 mm.; wings, 2.4 mm.

Female: Front chiefly silvery with only extreme upper portion, just below vertex, shining black; third segment of antennae more distinctly yellow; flexor bristles at bases of front femora more distinct than in male, bristles of middle coxae weaker; posterior trochanters without tubercles but with a patch of short hairs below, near bases; tarsi more flattened. Base of ovipositor globose, piercer almost twice as long as base and reaching just past the apical margin of the second abdominal segment. (fig. 7f).

Holotype male, Belle Glade, Florida, July 18, 1939 (D. E. Hardy); allotype female and seventeen paratypes, ten males, seven females, same data as type (R. H. Beamer, D. E. Hardy and A. T. Hardy); four males, eight females, Vero Beach, Fla., July 22, 1939 (D. E. Hardy, A. T. Hardy and R. H. Beamer); one male, Clayton, Ga.; May 18-26, 1911, 2,000 ft. (J. C. Bradley); one male, Douglas County, Kansas, Aug. 27, 1939 (R. H. Beamer) and three males, two females, Garnett, Kansas, August 29, 1939 (R. H. Beamer).

One paratype returned to Cornell University.

Tömösváryella turgida n. sp.

(Plate 2, Figs. 8a-8e)

This species belongs in the *vagabunda* group by having the posterior trochanters of the male tuberculate, it is separated from other members of this complex by the shape of the trochanteral development and the male genital structures.

Male: Head: Face and frontal triangle silvery, front shining black above junction of eyes; compound eyes joined for about one-third the length of the frontal triangle. Antennae brown to black, third segment acuminate (fig. 8a), rather thickly white pubescent; bristles of second segments short. **Thorax and Abdomen:** Polished in ground color, rather heavily gray to brown pollinose; margins of mesonotum and scutellum with distinct hairs, dorsocentral hairs strong; abdomen almost bare. Legs chiefly black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow, apical subsegment of tarsi brownish. Femora moderately thickened, spines weak, strongest on mid-femora; front pair each with a pair of flexor bristles near bases; middle coxae with three to four long yellow bristles apically. Posterior trochanters armed with a large blunt process in middle on their under sides, this development is about as long as the thickness of the trochanter at apex and about as thick as the trochanter at base (fig. 8b). Hind tibiae enlarged apically; hind tarsi flattened laterally, basitarsi about equal to next four tarsal subsegments. **Wings:** The third costal section is about one-third the length of the fourth; the fifth is about one and one-half times the length of the third and fourth combined. Crossvein r-m is situated much beyond the end of the vein R_1 and at the middle of

discal cell. Last section of fourth vein almost straight, last section of fifth slightly shorter than the posterior crossvein. Abdomen slender, slightly bulged at segments two and three and narrowing gradually towards the hypopygium; fifth abdominal segment but little longer than the fourth. **Hypopygium:** Almost equal to the fifth segment in length, eighth sclerite rather sharply pointed at apex on the right; apical depression very distinct and about in the middle; longitudinal groove slightly to the left of a median line; the membranous area is not protruded (fig. 8e). Ninth segment rather deeply V-shaped cleft on hind margin, longer than wide; claspers fairly simple, almost symmetrical, widely diverged towards their apices, not paralleled as in most species (fig. 8c).

Length: body, 2.8 mm.; wings, 2.7 mm.

Female: The association of the female cannot be certain, the specimens at hand apparently belong here. The front is silvery to the vertex; hind trochanters are normal in shape, tarsi more flat and dilated. Base of ovipositor subglobose, piercer longer than base (fig. 8d) reaching beyond the apex of second segment.

Holotype male, Griffin, Ga., Aug. 12, 1939 (D. E. Hardy); allotype female same locality and date (A. T. Hardy). Paratypes; six males same data, (R. H. Beamer, A. T. Hardy, J. D. Beamer); one male, College Station, Texas, June 23, 1938 (R. I. Sailer); one male Mildred, Kansas, Aug. 31, 1939 (R. H. Beamer); two males, Garnett, Kansas, Aug. 29, 1939 (R. H. Beamer), five males, Cherokee County, Kansas, Aug. 30, 1939 (R. H. Beamer); two males, Douglas County, Kansas, Aug. 26, 1939 (R. H. Beamer) and one male, Barberton, Ohio, Aug. 10, 1936 (L. J. Lipovsky):

A DISTRIBUTIONAL NOTE ON ACHALARUS LYCIADES (GEYER)

(Lepidoptera: Hesperiiidae)

This species already known to occur from southern New England to the Gulf and west to eastern Texas and southwestern Missouri has been found by the present writer to be rather abundant in Leavenworth and Douglas counties, Kansas during the latter part of May for the past several years (see Vol. 13, p. 28 of this Journal). A number of specimens were also taken by the writer in the Wichita Mountain National Forest, Oklahoma and at Romney in Eastland County, Texas. The Wichita Mountain material was collected on June 28, 1936 and the Romney specimens on June 30th and July 1st of the same year. These records extend the known frontier of the species some three hundred miles westward.

WILLIAM D. FIELD, Lawrence, Kansas

NEW AND LITTLE-KNOWN SPECIES OF ALLOEORHYNCHUS (HEMIPTERA: NABIDAE).

Halbert M. Harris, Ames, Iowa

It has been now more than thirty years since the appearance of Reuter and Poppius's intensive study of the genus *Alloeorrhynchus*. In continuation of my efforts to organize and extend our knowledge of this and other groups of Nabidae it seems desirable to present the following description and notes. The subgenus *Psilistus* has been discussed elsewhere (Proc. Royal Ent. Soc. London, (B), 6: 191-196, 2 figs., 1937).

Alloeorrhynchus venator, n. sp.

Obovate, the abdomen strongly widened to its middle; setose and also distinctly pilose. Shiny, only the metapleuron, scutellum, and the part of clavus interior to its inner row of punctures dull. Prothorax, except hind lobe of pronotum, and abdomen, except base and apex, first antennal segment, distal three segments of rostrum, all coxae and trochanters, base and extreme apex of all femora, and a more or less broad sometimes indistinct band around middle of all tibiae, luteous to golden yellow; the head, posterior lobe of pronotum (except irregular front margin), scutellum, clavus and apical half of corium, base and apex of abdomen and bands on femora and tibiae piceous to fuscous black. Head broader than long (21:15), unicolorous black, or paler on tylus and gula; the tylus prominent. Vertex fairly broad (9), barely raised above margin of eye. Ocelli almost twice as far apart as from eyes. Eye proportions, l:w:d=9:6:10. Antennae infuscated; segment I paler, except at base, II, III and IV rather thickly clothed with short, semi erect hairs; proportions, 11:2+21:19:20. Rostrum fairly long, segment I piceous, II extending between front coxae; proportions, II:III:IV=18:14:7.

Pronotum barely broader than long (34:33), the collar rather distinct, ring-like; the sides sub-parallel along basal half of anterior lobe, the disc rather evenly convex, front lobe more than twice as long as hind lobe (24:10). Scutellum bifoveate and irregularly rugose on the disc, the sides moderately swollen, the apex shiny, blunt, paler. Hemelytra greatly reduced, not contiguous behind scutellum, conspicuously pilose, the clavus with two rows of punctures; the corium entirely shiny, its basal half whitish testaceous; membrane evident, not reaching hind margin of second abdominal segment. Abdomen strongly widened to its middle, the second segment above coarsely punctate and more or less infuscate, the apical segment and genital segments, above and beneath, dark to piceous. Anterior and intermediate femora amplified and armed beneath as in related forms; the anterior femora measured within about two and a half

times as long as deep (34:11), their tibiae rather strongly widened, the fossorial pad moderately long (11). Ostiolar canal curved posteriorly, its apex broad and blunt. Venter convex, somewhat infuscated on each side at the base, the connexivum semi-erect, sometimes infuscated along the hind margin of the distal four or five segments. Male genital segment slightly asymmetrical, the left clasper (fig 1d) very large, its tip recurved, the right clasper (fig. 1c) distinctly shorter than left.

Length: male, 5.1 mm.; female, 6.0 mm. **Width:** pronotum, 1.6 mm.; abdomen, 2.3 mm.

Holotype, apterous male, Verulam, Natal, S. Africa, 4-7-97; and **allotype**, apterous female, Verulam, S. Africa (British Museum of Natural History). **Paratypes**, a male taken with holotype, and a male and female, Karkloof, Natal, S. Africa (British Museum and author's collection).

It should be noted that the amount of infuscation, especially of the basal abdominal segment, connexivum and tibiae and tarsi is variable. The hairs of the hind tibiae are fine, short and semipros- trate. In the Karkloof male the hind tibiae are much bowed.

Alloerrhynchus elegans Reuter

1882 *Alloerrhynchus elegans* Reuter, Ofv. Finska Vet.- Soc. Forh., 25:32,63.

1909. *Alloerrhynchus elegans* Reuter et Poppius, Acta Soc. Sci. Fenn., 37 (No. 2): 34, 38.

Female: head width, 19; vertex, 7. Eye proportions, l:w:d=9:6:10. Antennal formula, 9:2+20:17: (IV missing). Pronotum broader than long (38:34), the anterior lobe much longer than posterior (21:13). Rostral formula, II:III:IV=18:11:5. Anterior femur (measured beneath) slightly less than three times as long as deep (25:9). Anterior tibiae very strongly widened at apex, the length of the apical fossa (13) greater than depth of femur (fig. 2b).

Length: 5.67 mm. **Width:** pronotum, 1.7 mm.; abdomen 2.0 mm.

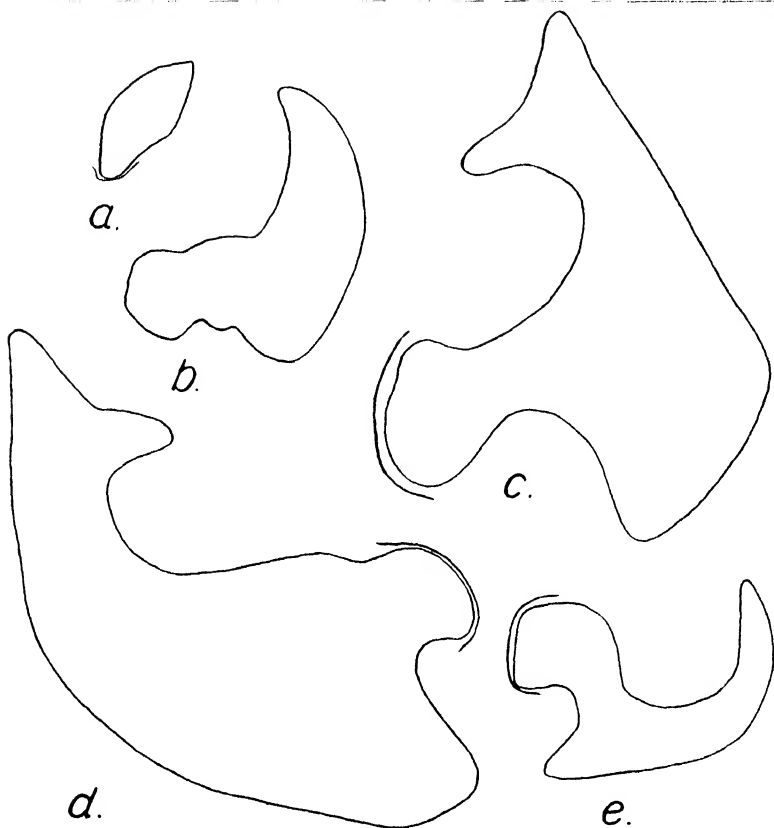
This species is represented in the British Museum material before me by four macropterous specimens from Durban and Malvern, S. Africa, and Matzoro Lakes, Gombe, N. Nigeria, Jan. 1929, Dr. Ll. Lloyd. Because of color variations in this and related species, a new study of the types is greatly needed. In the present specimens the head and hind lobe of pronotum (except lateral margins) are piceous black. The hemelytra are slightly shiny throughout. The apical two-fifths of clavus, a broad band occupying all of distal two-fifths of corium (except the outer apical angle), and a much narrower oblique band along the distal margin of corium, connecting these two are dark fuscous brown. The membrane is pale on basal half and has a large, rounded pale spot at the apex. The dark band on the

anterior femur is indistinct above, and is narrower than in related species, scarcely occupying more than a third of the length of the femur. The clavus is serially punctate but the corium not punctate. The male is smaller than the female and the clasper (fig. 1a) is minute, barely longer than diameter of hind tibia.

***Alloeorrhynchus distanti*, n. name**

1909 *Alloeorrhynchus collaris* Distant, Ann. Soc. Ent. Belg., 53: 374.

Unfortunately the *Prostemma collare* of Mink (1859) proved to be an *Alloeorrhynchus* and now stands as a synonym of *Alloeorrhynchus flavipes* (Fieber) 1836. This usage thus preoccupies the name in the genus making a new name necessary for Distant's form from India. I therefore propose the name *Alloeorrhynchus distanti* for *A. collaris* Distant.



EXPLANATION OF FIGURE

Figure 1. Genital claspers of the males (drawn to same scale).

a. Right clasper of *Alloeorrhynchus elegans* Reuter; b. right clasper of *A. gregalis* Harris; c. right clasper of *A. venator* Harris, n. sp.; d. left clasper of *A. venator* Harris, n. sp.; e. right clasper of *A. bellipotens* Harris, n. sp.

Alloeorrhynchus gregalis n. sp.

Elongate oval, rather slender, only slightly widened behind; setose and rather strongly pilose. Shiny, the metapleuron, scutellum and hemelytra, except narrow inner border of clavus and the distal half of corium, somewhat dull. Head, basal two-thirds of hind lobe of pronotum, mesothorax and metathorax beneath and apical segment of abdomen and genital segments piceous to black; scutellum, clavus, a fairly large diamond-shaped spot on the distal part of corium, except triangular area in outer apical angle, and membrane dark fuscous to black; prothorax above and beneath, except basal two-thirds of pronotum, and venter, except apex, luteous to golden yellow. Basal half of corium and its outer apical angle whitish to yellowish-testaceous. Antennae dark testaceous to fuscous, the basal segment pale. Legs testaceous, the front femur, except at base, apex, and more or less of its dorsal surface, the apex of front tibiae, broad rings at apex of middle and hind femora, middle and hind tibiae, and all tarsi embrowned to piceous.

Head broader than long (19:15). Vertex fairly broad (9), distinctly arched above the eyes. Eye proportions, $l:w:d=8:5:9$. Antennal proportions, $9:2+20:20:20$. Rostrum with segment I piceous; II embrowned basally, extending between anterior acetabula; proportions, $II:III:IV=16:13:6$. Pronotum barely broader than long (macropterous, 37:35; brachypterous, 34:32), the collar short, ring-like, the sides of the front lobe almost parallel, the hind lobe barely half as long as front (11:24), slightly raised above it and with a very faint median impression. Scutellum bifoveate and rugose on disc. the sides slightly swollen, the apex shiny.

Hemelytra rather thickly clothed with fine, pale, semi-erect hairs, narrow, tapering posteriorly, slightly constricted at the middle, the clavus biserially punctate, the membrane half as broad as long (25:50), about attaining tip of abdomen, its apex slightly paler. Four front legs widened and armed on femur and tibia as in related forms, the front femur (fig. 2d) measured beneath barely more than two times as long as deep (25:12), the intermediate femora with the ampliation nearer apex than base; the front tibia less strongly widened than in *A. venator*, n. sp., the apical pad moderately short (7). Hairs of hind tibiae sub-erect, much longer than diameter of tibia. Ostiolar canal much narrower than in *venator*, n. sp. Venter convex, constricted at the base. Male clasper (fig. 1b) broad, its length slightly greater than diameter of hind femur.

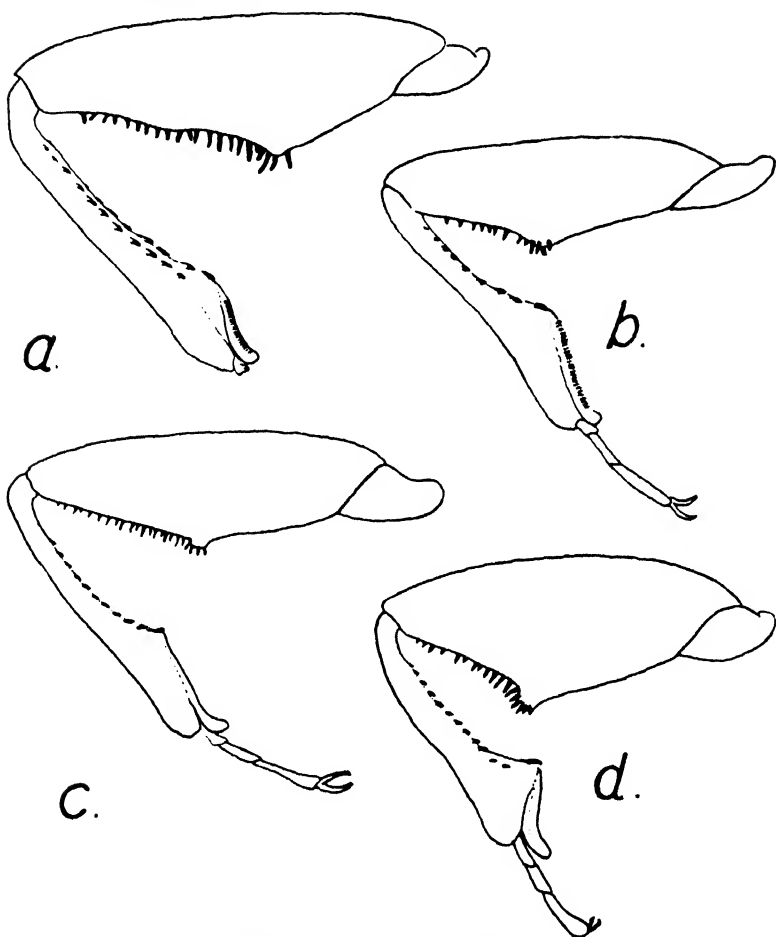
Length: male, 5.0 mm.; female, 6.0 mm. Width: pronotum 1.45-1.6 mm.; abdomen, 1.6-2.0 mm.

Brachypterous form: Hind lobe of pronotum slightly less arched than in winged form. Hemelytra strongly reduced, the membrane

small, oblique, scarcely extending beyond apex of corium, its tip barely reaching to base of fourth segment of abdomen.

Holotype, macropterous male, P. Town, South Africa, and **allotype**, macropterous female, Port Shepstone, S. Africa (British Museum of Natural History), **Paratypes**, macropterous female, Port Shepstone, Natal, 5-'97; macropterous female, Verulam, S. Africa, 4-7-'07; and brachypterous male and female, Malvern, Natal, S. Africa.

In color markings this species is very similar to *A. venator*, n. sp., differing principally in that the coloring of the front lobe of



EXPLANATION OF FIGURE

Figure 2. Anterior femur and tibia as seen from the side (drawn to same scale).
a. *Alloeorrhynchus furens* Harris, n. sp.; b. *A. elegans* Reuter; c. *A. flavolimbatus* Kirkaldy; d. *A. gregalis* Harris, n. sp.

the pronotum is continuous over the transverse impression and conspicuously encroaches upon the hind lobe, and that the base of the abdomen on each side beneath and the connexival segments are without distinct darker markings. Also the apex of the corium at the outer angle is pale. In form it is distinctly more slender and the eyes are smaller, the hemelytra of the brachypterous form are more strongly developed, the anterior tibia is less strongly widened distally, the ostiolar canal is narrower and the male clasper is much smaller and of entirely different nature.

***Alloeorrhynchus bellipotens*, n. sp.**

Size, color, and vestiture about as in *A. venator*, n. sp., and *A. gregalis*, n. sp., the body not as elongate as in *gregalis*. Humeri of pronotum pale, the disc of posterior lobe deeply infuscated to black. Anterior lobe of pronotum, connexivum and venter paler than in above named species, more nearly flavous. Hemelytra broader than in *gregalis* and not so noticeably constricted as there, the pale markings of corium less extensive, internally not going beyond a point opposite apex of scutellum. Eyes and antennae about as in *gregalis* the anterior femora longer and the front tibiae more greatly expanded than in that species but not so greatly as in *A. venator*. Membrane attaining apex of abdomen, not twice as long as broad, or (brachypterous) reaching to base of first genital segment. Male clasper (fig. 1c) moderately large, slender, curved into a distinct hook.

Length: 4.4-5.2 mm. **Width:** pronotum, 1.52 mm; abdomen, 2.00 mm.

Holotype: brachypterous male, and **allotype** brachypterous, female, Durban, Natal, S. Africa, Bell-Morley, 1911 (In British Museum). **Paratypes**, male and female taken with types and macropterous female, Emmons, S. Africa, Aug. (collections of author and British Museum).

In many respects this species seems intermediate between *venator* and *gregalis*. The pale humeri, less infuscate legs, less extensive pale area at base of corium, dark apex of corium, broader pronotum, longer hemelytra in brachypterous form, and the nature of front legs and clasper differentiate it from those forms, however.

***Alloeorrhynchus furens*, n. sp.**

Yellowish-testaceous to sordid-testaceous, the hind lobe of pronotum, excluding an irregular, sinuate band at its base, piceous black. Connexivum maculate. Legs indistinctly darker at middle of front femora, on apical third of middle and hind femora, and on tibiae. Head broader than long (22:17), darker around the basal impression. Vertex flat, wide (8). Eye large; proportions, l:w:d=10:7:11. Antennae testaceous, the first segment paler at base and extreme apex; proportions, 11:2+21:21:24. Rostrum pale, the first segment embrowned; proportions, II:III:IV=23:16:6.

Pronotum broader than long (47:38), the anterior lobe pale with an oblique dark crescentic spot on each side of middle in front, much longer than posterior lobe (24:14); posterior lobe arched, slightly impressed within the humeri, the pale area along hind border widened at the middle and on the humeri. Scutellum bifoveate, rugose, dusky, the sides (indistinctly) and the apex paler. Hemelytra brownish testaceous, the basal half of the clavus, except along the claval vein, and three spots on costal margin of corium (an elongate, posteriorly widened one along the basal two-fifths, a triangular one occupying the outer apical angle, and a small irregular circular one between the other two but nearer the first) indistinctly paler. Membrane smoky, translucent. Anterior femur (fig. 2a) with the ampliation slightly nearer base than apex, less than three times as long as deep (34:12), irregularly infuscated on each side. Anterior tibia rather suddenly but only moderately widened at apex, the fossorial pad short (8). Posterior tibia stout, its hairs oblique, and slightly longer than its diameter. Meso- and metapleura embrowned to fuscous, the ostiolar canal narrow. Venter pale, the base slightly embrowned on each side; connexivum with the outer apical angle of the last five segments darkened, the apical ones rather indistinctly.

Length: 6:8 mm. **Width:** pronotum, 2.1 mm.; abdomen, 2.3 mm.

Holotype: female, E. Africa, Rd. to Kilossa, Usagara Dist., Dec. 22-26, 1910, S. A. Neave. (British Museum). **Paratypes,** 2 females, Durban, Natal, S. Africa, 1897.

The species is recognized by its large size, the pale basal band on hind lobe of pronotum, the infuscated hemelytra and legs, the position of the ampliation on front femur and the nature of fore tibiae and eyes.

***Alloeorrhynchus flavolimbatus* Kirkaldy**

1908 *Alloeorrhynchus flavolimbatus* Kirkaldy, Proc. Linn. Soc. N. S. Wales, 32:781.

1909 *Alloeorrhynchus flavolimbatus* Reuter et Poppius, Acta. Soc. Sci. Fenn; 37 (2): 35, 42.

Female: Head broader than long, the tylus convex and raised basally. Vertex flat, wide (3); gula convex. Eyes moderate, 8:6:10. Antennae, 10:2+20:21:22. Rostrum stout, the second segment extending between front coxae; proportions, 22:16:6. Pronotum broader than long (41:35). Clavus biserially punctate. Anterior femora (fig. 2c) with a few piceous granules along basal half, the distal half, regularly, serially dentate, measured within, only three times as long as deep (30:10). Anterior tibiae strongly widened distally, the inner edge only slightly curved, the apical pad very long (14). Venter piceous black, broadly pale at the middle on basal half. Abdomen above orange yellow basally.

I have a female example, Brisbane, Australia, June 7, 1915, Henry Hacker, collector. This specimen agrees well with Kirkaldy's color description. There is also at hand a carded female example (British Museum), Kokoda, Papua, 1200 ft., Sept. 1933, L. E. Cheeseman. This example differs from the Brisbane one in that the femora are golden and the venter is entirely black and probably can be no more than a variety of Kirkaldy's form. It should be noted that this Papua example agrees rather perfectly with the description of *A. nietneri* Stein from Ceylon. Males of these forms will have to be studied in order to understand their relationship.

***Alloeorrhynchus instabilis*, n. sp.**

Slightly smaller and slenderer than *A. flavolimbatus* Kirkaldy; the vestiture, color and markings much as in that species. Head, pronotum, propleura, mesothorax on sides and beneath, and abdomen, except at middle beneath and spots on connexival segments, shiny, piceous black. Scutellum, clavus, distal half of corium, and membrane, dull, fuscous black. Basal half of corium, first segment of antennae, rostrum, legs, a large patch at base of venter, and irregular spots on connexivum, yellowish testaceous. Head broader than long (18:15). Eyes, 8:6:10. Pronotum broader than long (35:30), distinctly smoother than in *flavolimbatus*, the front lobe more sharply delimited than there. Scutellum bifoveate, the sides swollen, the apex distinctly produced and pointed. Clavus with two rows of punctures, paler basally next to corium. Corium shiny along costal margin, more broadly so along basal third, without distinct punctures. Membrane paler at inner basal angle. Antennal proportions, 10:2+21:20:26; the distal segments fuscotestaceous. Rostrum long, pale, proportions, 22:15:6. Anterior femora slender, widened at basal third and conspicuously armed from there to apex, as measured within three times as long as deep (27:9). Intermediate femora denticulate within on distal half. Hind femora slightly darkened on apical third. Front tibia long, slender, only slightly widened distally, the apical pad shorter than diameter of femur (7:9). Hairs on hind tibia shorter than diameter of tibia. Venter shiny.

Length: 5:13 mm. **Width:** pronotum, 1.52 mm.

Holotype: macropterous female, Gordon Vale, Queensland, Australia, E. Allen, 1935 (author's collection).

The species is recognized by its more slender form, pale basal two-thirds of inner cell of corium, long rostrum, and slender front femora and tibiae.

***Alloeorrhynchus incertus*, n. sp.**

Color and pattern as in *A. flavolimbatus* Kirkaldy, but the body stouter and the appendages much shorter. Eyes slightly smaller than in *A. instabilis*, not so prominent. Antennae fuscotestaceous,

segments I and II paler except at their distal ends; proportions, 9:2+18:17:19. Rostrum embrowned, very short and stout; proportions, 12:10:4. Pronotum much broader than long (36:28), the sides strongly sinuate, the disc of hind lobe somewhat paler than humeri and disc of front lobe. Scutellum noticeably smaller than in *flavolimbatus*, and not so strongly swollen along the sides. Hemelytra narrowed distally, the sides straight, not constricted as in *flavolimbatus* and *instabilis*, the clavus punctate as in those forms, but the corium also with a row of coarse punctures. Margin of anterior acetabula pale, the front tibiae and femora, and a distal ring on middle and hind femora embrowned. Front femora short, stout (24:10), widened at the basal third, the spinules from there outwards much smaller than in *flavolimbatus*. Intermediate femora angularly amplified and armed about as in related forms. Hind tibiae stout, pilose and setose, the longer hairs semi erect and longer than diameter of tibia. Connexivum pale, the hind margins of the distal five segments piceous brown. Venter piceous, the genital valves paler.

Length: 5:12 mm. **Width:** pronotum, 1.56 mm; abdomen 1.83 mm.

Holotype: Macropterous female, Brisbane, Queensland, Australia, February 24, 1924, H. Hacker, (author's collection).

The species differs in color from *flavolimbatus* Kirkaldy in that the front legs are more embrowned, the corium is embrowned at the base and its pale area is widest distally. In Kirkaldy's species the extreme base of corium is pale and the pale area widens to its middle then tapers outwardly. Also in that species the first two dark spots on connexivum tend to converge. The shiny costal area of the corium is greater in extent and the ostiolar canal is smaller and more slender in the new species than in *flavolimbatus*.

A DISTRIBUTIONAL NOTE ON *HETEROCHROA BREDOWII* (GEYER).

(Lepidoptera: Nymphalidae)

Heterochroa bredowii bredowii (Geyer), typically found in southern Arizona and in Mexico was observed by the present writer to occur at Concan in Uvalde County, Texas and Leaky in Real County, Texas on July 7th and 9th, 1936. A number of specimens were seen and a few specimens were captured. Among these were a number of freshly emerged specimens. This extends the known distribution of the butterfly some four hundred or more miles to the east. Recently a single female specimen of this species was found near Scott City, Kansas (see elsewhere in this Journal) but it can only be regarded as a visitor in Kansas.

WILLIAM D. FIELD, Lawrence, Kansas

A FIELD METHOD FOR ESTIMATING MORMON CRICKET INJURY TO FORAGE

Ralph B. Swain¹

Bureau of Entomology and Plant Quarantine

In numerous localities in the Northwestern States the Mormon cricket (*Anabrus simplex* Haldeman) has been so abundant during the past several years that concern as to the effect of their feeding upon range forage plants has been aroused. Mormon cricket injury to crop plants (plants of one species, of a rather uniform density, height and weight) is fairly difficult to estimate ocularly on a volume basis; injury to range plants is much more so. In the latter case damage to a great variety of species of widely varying heights and volumes must be estimated.

Field observation during the spring of 1938 on the feeding habits of the Mormon cricket indicated that the injury to plants was of a purely mechanical nature, resulting in the removal of portions of the plant tissue, and that in general it commenced at the peripheries, leaf tips, or inflorescences and proceeded toward the centers or lowest above-ground portions of the plants. The resemblance of at least the more severe Mormon cricket injuries to the results of grazing suggested that perhaps methods already developed for estimating forage production and utilization by livestock might be of service in the present instance. It is the purpose of the following discussion to show how the reconnaissance method of range survey may be useful as a means of roughly and rapidly estimating Mormon cricket damage to forage.

"Forage," as a range-management term, is considered to be that portion of the vegetation which is available to and usable by livestock. Although "grazing capacity" (the maximum number of livestock which a range unit will support each season over a period of years without injury to the range and other related land uses and services) is not specifically considered here, it is obviously dependent upon the forage production.

The reconnaissance method is used for determining the grazing capacities of vegetation types. It requires the listing of all forage species present within a type, together with their respective percentages of the plant composition, and the estimation of the density of the type. These are the only data collected in the field with respect to vegetation.

To compute the forage production for the type, the percentage compositions of the plant species must be multiplied by their respective "proper-use factors" and the products added. This sum is then multi-

¹General Supervisor, Mormon Cricket Control Project, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture.

plied by the density estimate. The proper-use factor of a plant species is the percentage of the total current year's growth within reach of livestock that is utilized when the ranges are properly grazed. These factors are average figures, determined by tedious observation and experiment, and published in tabular form for use in range surveys by the Division of Range Research of the United States Forest Service and cooperating Federal and State agencies. The procedure for determining grazing capacities is not the concern of this paper. It is described in a mimeographed pamphlet entitled "Instructions for Range Surveys." For our purpose it is necessary to follow this procedure only to determine the forage production on a given area. The necessary field data are those which would be collected through an ordinary reconnaissance survey, with the addition of estimates of the average percentage utilization by the Mormon cricket of each major forage-plant species composing the vegetation type examined. Since, in the present instance, cricket utilization is to be compared with the proper livestock utilization on the same area, density need not enter into the computation.

Table 1 illustrates how data from field observations on a 1-10th acre plot in Elko County, Nev., were arranged in order to compute the loss of forage due to Mormon cricket feeding. The forage species present are listed at the left of the table and the field estimates of percentage composition of the plants and percentage utilization by the Mormon cricket are found in columns 1 and 6, respectively. The percentages of cricket utilization are average figures derived from ocular estimates of the reduction in volume of mature, individual plants.

These ocular utilization estimates for a plant species can be made by multiplying the estimated percentage of plants exhibiting Mormon cricket injury by the estimated average percentage utilization of the individual plants. This is the method generally used in the reconnaissance type of vegetation survey. Intensive practice in estimating the utilization of individual plants is necessary before one can achieve reasonable accuracy. Comparisons of injured and uninjured plants of the same stage of development and of about the same original size are necessary. Such plants can usually be found within a very small area at the point of observation. Estimates may also be roughly checked by weighing with a hand scales equal numbers of injured and uninjured plants, and comparing the percentage difference in weights with the percentage utilization estimate made ocularly. Both these methods and others as they are applied to studies

²Inter-agency Range Survey Committee, 1937. Instructions for range surveys as formulated by the Inter-agency Range Survey Committee and adopted by the Western Range Survey Conference, April 24, 1937. (Approved by Chief, U. S. Forest Service, etc.) Mimeographed.

of range-grass utilization have been described and compared in a single paper.³

As no density estimates were taken, the figures presented in Table 1 are relative values and, as such, useful to show percentage losses resulting from cricket injury.

Since cattle and horses differ somewhat from sheep and goats in the degree to which they will ordinarily utilize a given plant species under proper range management, there are two sets of proper-use factors, columns 2 and 4. In the table C&H signifies cattle and horses; S&G, sheep and goats; and PUF, proper-use factor. The relative amounts of forage available to the two classes of livestock under proper utilization have been found by multiplying the percentage compositions of the various plants by their respective proper-use factors. The totals of columns 3 and 5 are these relative amounts. The comparative amount of herbage taken by Mormon crickets is the total of column 7, the figures of which were obtained by multiplying the percentages of composition of the plant species by the respective percentages of utilization.

The amounts of forage remaining for livestock after Mormon cricket feeding are the totals of columns 8 and 9, which were obtained by subtracting the weighted cricket-utilization estimates of column 7 from the figures of columns 3 and 5. The difference between the amount of forage remaining for livestock and the total forage originally available is the amount of forage eaten by crickets. The percentages of forage destroyed by crickets are computed by dividing the cricket consumption by the total forage. These are 44 percent for cattle and horses and 48.6 percent for sheep and goats. The proper-use factors of the table were taken from "Proper Use Factor Table, Nevada District No. 1," approved tentatively by the United States Forest Service and other agencies at Reno, Nev., September, 1938.

The 1-10th acre plot for which the figures of Table 1 are given was established about 35 miles northwest of Elko on the Stewart Ranch, Elko County, Nev., June 17, 1938. The vegetation type was shrub with *Artemisia tridentata* and *Chrysothamnus viscidiflorus* the dominant species. Mormon crickets are believed to have been continuously present in the plot from June 1 to June 27 at average concentrations of about five per square yard.

The estimate of Mormon cricket damage to forage plants derived by the reconnaissance survey method does not present the entire picture of the destruction to the total herbage on a range unit. It fails in two respects. Firstly, damage to non-forage species, which occasionally make up a very large proportion of the plant density, is not

³Pechanec, J. F., and Pickford, G. D. 1937. A Comparison of Some Methods Used in Determining Percentage Utilization of Range Grasses. Journal of Agricultural Research 54: 753-765.

TABLE I

Mormon Cricket Damage to a Tenth-acre Range Plot in Terms of Relative Seasonal Forage Production Loss for Cattle and Horses and for Sheep and Goats, 1938

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Forage species occurring in the plot	Percentage composition	P U F (C&H)	Herbage available to C&H (1)(2)	P U F (S&G)	Herbage available to S&G (1)(4)	Percentage utilization by crickets	Herbage taken by crickets (1)(6)	Forage left for C&H (3)-(7)	Forage left for S&G (5)-(7)
<i>Poa nevadensis</i>	5	80	4.00	60	3.00	10	.50	3.50	2.50
<i>Poa secunda</i>	5	45	2.25	40	2.00	50	2.50	0	0
<i>Oryzopsis webberi</i>	5	55	2.75	50	2.50	50	2.50	.25	0
<i>Sitanion hystrix</i>	10	20	2.00	20	2.00	35	3.50	0	0
<i>Stipa thurberiana</i>	5	60	3.00	40	2.00	35	1.75	1.25	.25
<i>Phlox canescens</i>	5	10	.50	10	.50	5	.25	.25	.25
<i>Artemisia tridentata</i>	40	10	4.00	10	4.00	0	0	4.00	4.00
<i>Chrysothamnus viscidiflorus</i>	25	10	2.50	10	2.50	0	0	2.50	2.50
Totals	100		21.00		18.50		11.00	11.75	9.50
Cattle and horse forage taken by crickets = sum of col. (3) minus sum of col. (8) = 21.00 - 11.75 = 9.25									
Forage available to C&H taken by crickets = Forage taken by crickets = 9.25 = 44%.									
Forage available to C&H									
Sheep and goat forage taken by crickets = sum of col. (5) minus sum of col. (9) = 18.50 - 9.50 = 9.00.									
Forage available to S&G taken by crickets = Forage taken by crickets = 9.00 = 48.6%									
Forage available to S&G									

shown by this method. Secondly, cricket utilization exceeding the proper-use factor for livestock is not reflected in the percentage of forage destruction. However, for the purpose of evaluating Mormon cricket damage to livestock forage, this may prove a fairly reliable and useful field method.

To Mr. W. R. Chapline of the Division of Range Research, United States Forest Service, the writer is grateful for general suggestions and criticisms. He is grateful to Dr. George Stewart and Mr. Selar S. Hutchings, Intermountain Forest and Range Experiment Station, Ogden, Utah, for generously assisting in the preparation of the table and for critically reading the completed manuscript.

INTRAVENOUS INJECTIONS OF ARSENIC INEFFECTIVE IN CONTROLLING HORN FLIES ON CATTLE

W. G. Bruce

Bureau of Entomology and Plant Quarantine

An experiment has been conducted to determine the possibility of injecting sufficient arsenic into the blood stream of a bovine to make the blood toxic to horn flies (*Haematobia irritans* (L.)) and other blood-sucking flies feeding upon the animal.

A commercial form of trivalent arsenic (meta-amino-para-hydroxyl phenyl arsine oxide), used extensively in antisyphilitic therapy, was used in this test. The arsenical was obtained in powder form, mixed with sufficient alkali and sucrose to make a practically neutral and isotonic aqueous solution. The solution was prepared by dissolving the powder in sterile distilled water.

In a preliminary test 0.06 gram of the arsenical dissolved in 10 cubic centimeters of sterile distilled water was mixed with 120 cubic centimeters of defibrinated bovine blood and fed to 96 caged horn flies. As a check 10 cubic centimeters of sterile distilled water was mixed with 120 cubic centimeters of the blood and fed to 102 horn flies in another cage. In less than 22 hours after the blood was supplied all the flies fed blood containing arsenic were dead, whereas only 5 of those in the check cage were dead. These results led to further tests to determine whether sufficient arsenic could be injected into the blood stream of an animal to render its blood toxic to horn flies.

A 450-pound heifer was confined in a screened building and maintained on a ration of bran and prairie hay. The arsenical was injected into the jugular veins with a sterile glass syringe of 10-cubic centimeter capacity and fitted with a sharp, short-bevel, 21-gage needle. Nine injections of 0.06 gram of the arsenical in 10 cubic centimeters of sterile distilled water followed by ten injections of 0.4 gram in the same quantity of water were given. The first six injections were made at 2-day intervals, the seventh followed a 3-day interval, the eighth 1 day later, and the ninth 2 days thereafter. The 0.4-gram doses followed immediately after the small doses. The first six of these were injected at 2-day intervals, the seventh following a 4-day interval, the eighth on the next day, the ninth 7 days thereafter, and the tenth on the following day.

The animal was periodically infested with horn flies.

A sample of the droppings was collected at least once each day, infested with 100 horn fly eggs, and kept in an individual screen cage in order that adult emergence could be noted.

The arsenical had no apparent effect upon the horn flies feeding on the animal.

The injections of the 0.06-gram doses apparently had a beneficial effect upon the animal, as indicated by an increased appetite, sleek coat of hair, and excellent general condition. The injections of the 0.4-gram doses had no apparent ill effect when given at 2-day intervals, but when injected at 1-day intervals they caused loss of appetite, glassy appearance of the eyes, puffiness around the eyes, unsteadiness of gait, soreness of the leg joints, and poor general condition. The animal remained in poor condition for about 3 weeks following the last injection.

Evidently a large proportion of the arsenical is excreted in the feces and urine, and it is impossible to build up enough arsenic in the blood stream to be toxic to horn flies. Sufficient arsenic was excreted in the droppings to be toxic to horn fly larvae. Adult emergence from the samples of droppings was quite irregular and at times as low as 7 percent.

One day after the last injection the heifer was artificially wounded and infested with approximately 150 larvae (4 to 6 hours old) of *Cochliomyia americana* C. and P., to determine the toxicity of the arsenical to screw-worms. The larvae were developing normally at the end of the third day, when all but about 50 were removed. These larvae completed normal development, pupated, and normal flies emerged. The flies were kept in a screen cage and, in due time, viable eggs were deposited.

The heifer died of blackleg about 2 months after the last injection of arsenic.

A NOTE ON ARGYNNIS CYBELE KRAUTWURMI HOLLAND

(Lepidoptera: Nymphalidae)

Dr. Holland¹ gave the name *krautwurmi* to a supposed new subspecies from the Upper Peninsula of Michigan. The writer has recently studied a series of males from near the type locality. They are not in the least different from typical *cybele* males and the name *krautwurmi* does not represent a distinct subspecies. The specimens upon which Dr. Holland based his description of *krautwurmi*, do, however, represent a dimorphic female form of *cybele* and the name may be retained in this connection. This female form is quite common in Kansas and differs from typical female *cybele* in having a pale buff ground color on the upper surfaces instead of the bright yellowish brown color. Also the basal areas of both wings above are very dark in color in *krautwurmi*.

WILLIAM D. FIELD, Lawrence, Kansas

¹The Butterfly Book, p. 87, pl. LVI, fig. 2, 1931.

A NEW ENITHARES FOR AUSTRALIA (NOTONECTIDAE-HEMIPTERA)

H. B. Hungerford, Lawrence, Kansas*

Up to the present time there has been recorded for Australia only one species of *Enithares*. This is *Enithares bergrothi* Mont. I have, however, a series of another species that is readily separated in both sexes from *E. bergrothi* Mont., the males by the protuberance on the anterior trochanter, and the females by the broad, middle tibia that has a marked constriction at the base opposite the femoral tooth.

Enithares hackeri n. sp.

Size: Length 9.9 to 10.2 mm.; width at humeri 3.3 to 3.6 mm. It is thus a slightly smaller species than *E. bergrothi* Mont.

Color: Since color is quite variable in the genus, it is possible that the specimens of the type series do not represent the color possibilities. All the specimens at hand are quite light, the scutellum conspicuously so. In the darker specimens, the dark abdomen shows through the hyaline hemelytra. In a similar way, there may be an irregular dark band showing through the caudal portions of the pronotum. The hind femora may be longitudinally striped beneath, as in *E. bergrothi* Mont., and the protuberances on the anterior trochanters of the males may be black.

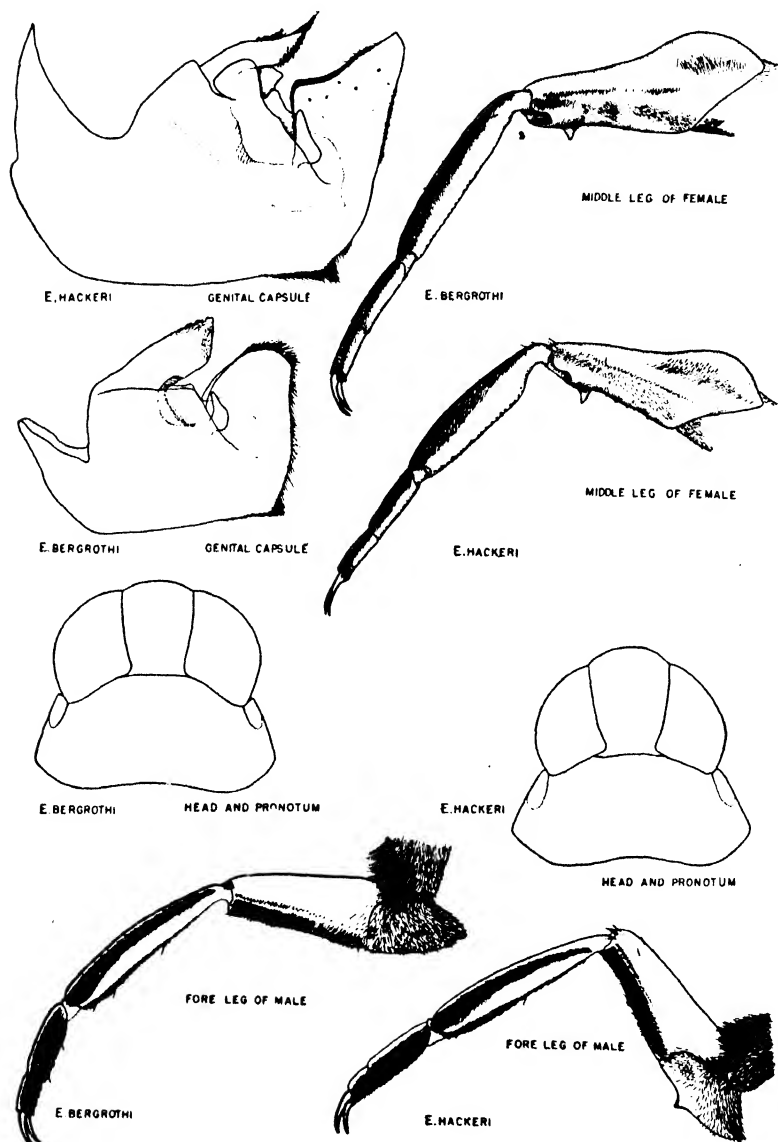
Structural Characters: Head relatively longer, narrower, and less truncate in front than in *E. bergrothi* Mont. The anterior breadth of vertex: synthlipsis:: 43: 23. The length of vertex a little greater than its anterior breadth. The head a little longer than the pronotum. The length of pronotum: length of scutellum:: 9: 16. The anterior trochanter of the male is provided with a tubercle and a fairly large field of small spines, as shown in Figure 8. There is also a row of spines confined to the distal half of the femur. The middle femur has a similar field of spines near the base and a continuous median row. The tibia is broad with a marked constriction at the base opposite the femoral tooth in both sexes (see Figures 2 and 4). The male genital capsule as shown in Figure 1.

Location of Types: Types are in the Francis Huntington Snow Entomological Museum and a pair of paratypes in the South Australian Museum at Adelaide. The type series consists of eight males and nine females bearing the label "Australia, Brisbane, Queensland, Dec., 1932, H. Hacker," and three males labeled "F. Armstrong, Began River, N. S. W. Australia via Mr. Deane."

Comparative Notes: This species is readily distinguished from *Enithares bergrothi* Mont. by its more elongate head, by its broad middle tibia, which is conspicuously constricted at the base, and by

*Contribution from Department of Entomology, University of Kansas.

the tubercle on the anterior trochanter of the males. The male genital capsule is also different, as shown in the drawings. The only other *Enithares* I recall having the male provided with a protuberance on the anterior trochanter is *Enithares chinai* Jaczewski, from Africa.



**MINUTES OF THE SIXTEENTH ANNUAL MEETING
KANSAS ENTOMOLOGICAL SOCIETY
UNIVERSITY OF WICHITA, WICHITA, KANSAS
MARCH 30, 1940
BUSINESS MEETING**

President R. T. Cotton called the meeting to order at 10:45 A. M. in room 119, Science Hall.

The minutes of the 15th annual meeting were read and approved.

REPORTS OF OFFICERS

The Secretary-Treasurer's report was read and approved. A summary of the report is as follows:

Receipts, April 1, 1939 to March 25, 1940	\$690.69
Lisbursements, April 1, 1939 to March 25, 1940	356.13
Balance, March 25, 1940	\$334.56
Assets:	
U. S. Savings Bonds, Maturity value \$850.00	\$637.50
Balance in checking account	334.56
Accounts receivable	4.25
Cash on hand	3.50
Unexpended Balance, mailing acct. Manhattan P. O. ...	9.24
	\$989.05

Liabilities: NONE

Net assets, March 25, 1940

REPORT OF THE EDITOR OF THE JOURNAL:

March 29, 1940

To the Entomological Society of Kansas:

Since the last meeting of the Society the four issues of the JOURNAL have been published. The new format and the publishing arrangements seem to the Editor to be a decided improvement, for which we are grateful to the printers and to Mr. Walkden for making the necessary arrangements.

During the past year the Editor has been handicapped by a distinct lack of manuscripts for publication, with the result that there has sometimes not been sufficient variety of articles in a given number. In addition, there has been some unused space because of a lack of very short articles or notes, which might have been used for fill-ins at the ends of larger articles. At the present time, there is not enough copy on hand for the next issue. In view of this situation may we urge, first, that all members of the Society submit as soon as possible manuscripts for articles which they wish published during the coming year. If these are submitted far enough in advance, better choice can be made of the articles for each issue. May we urge, in the second place, that all members of the Society be encouraged to submit brief notes which may be used for fill-ins. Such notes could frequently be submitted even by under-graduate students who have made some interesting observations as to occurrence, behavior, life history, or some other interesting observation having to do with insect life.

The Editor is heartily in favor of effecting some arrangement whereby our JOURNAL becomes also the journal of the Texas Entomolog-

ical Society. The above report will show that we have a medium of publication which has room for more papers than we have been receiving. Undoubtedly, the addition of the Texas Society would strengthen the JOURNAL, so that after awhile it may be possible to increase the number of pages, thus making a very strong journal for the Middle West. In case such arrangement is made, it would be entirely proper to change the Editorial Board to give full representation to the Texas Society.

Respectfully submitted,

PAUL B. LAWSON, Editor

REPORT OF THE AUDITING COMMITTEE FOR 1940:

The Treasurer's accounts for the period April 1, 1939 to March 25, 1940 have been audited and found to be in order.

(Signed) D. A. Wilbur, W. T. Emery.

On motion, the report of the auditing committee was accepted.

APPOINTMENT OF COMMITTEES:

President Cotton appointed the following committees:

RESOLUTIONS: R. H. Painter, L. C. Woodruff, Chas. Curtiss.

NOMINATIONS: D. A. Wilbur, R. H. Beamer, D. B. Whelan.

AUDITING FOR 1941: H. R. Bryson, E. T. Jones.

OLD BUSINESS: NONE.

NEW BUSINESS: Dr. R. L. Parker discussed the correspondence he has had with a committee of the Texas Entomological Society relative to the affiliation of that Society with the Kansas Entomological Society for the purpose of publication of their proceedings and papers. A plan of affiliation has been drawn up by the Executive Committee of the Kansas Entomological Society and submitted to the publication committee of the Texas Entomological Society. If this plan is acceptable to the latter Society, it will provide for the publication of papers and proceedings originating in either Society, and will not involve any changes in the present set-up of the Kansas Journal except proper recognition of the Texas Society.

On motion, it was decided to appoint a Special Committee to deal with the Texas Entomological Society, the committee to consist of the Executive Committee and two additional members appointed by the President.

Then followed the presentation of papers, the program consisting of 28 titles, as follows:

1. A Discussion of Hessian Fly Resistance in Certain Wheat Varieties. E. T. Jones, U. S. Bur. Ent. and P. Q., Manhattan, Lantern. 10 min.
2. Host Relations and Geographic Distribution of New Species of Mexican Eurytomidae. Robt. E. Bugbee, F. H. K. S. C., Lantern. 10 min.
3. Observations on Sod Webworms of Kansas. H. D. O. Miller, K. S. C. 10 min.
4. The Alfalfa Plant Bug, *Adelphocoris lineolatus* (Goeze) Found in Kansas. Chas. Curtiss, K. S. C. 5 min.
5. Biology and Taxonomy of Bombyliid Predators on Grasshopper Eggs. R. H. Painter, K. S. C. 10 min.
6. The Role of Plastics in the Field of Entomology. Don B. Whelan, U. of Nebr. 10 min.

Afternoon session, 1:30 p. m.

7. Observations on the Seasonal Variation in Resistance of Some Stored Products Insects to High Temperature. H. H. Walkden, U. S. Bur. Ent. and P. Q., Manhattan. Lantern. 10 min.
8. Insect Infestation in Railroad Box-cars. T. F. Winburn, U. S. Bur. Ent. and P. Q., Manhattan. Lantern. 10 min.
9. Insect Infestation in Farm-stored Grain in Kansas. T. F. Winburn, U. S. Bur. Ent. and P. Q., Manhattan. Lantern. 10 min.
10. Field Infestation of Wheat in Kansas and Nearby States. R. T. Cotton and T. F. Winburn, U. S. Bur. Ent. and P. Q., Manhattan. Lantern. 10 min.
11. The Ninth Annual Insect Population Summary of Kansas Covering the Year 1939. R. C. Smith and E. G. Kelly, K. S. C. 10 min.
12. A Study of Kansas Thyreocoridae. R. I. Sailer, U. of K. 7 min.
13. Insect Growth Studies. L. C. Woodruff, U. of K. 7 min.
14. Some New Records of Kansas Arthropods. Louis Lipovsky. U. of K. 7 min.
15. Some New Distributional Notes on Hesperidae. Wm. D. Field. U. of K. 7 min.
16. Okefenokee Swamp, Georgia in 1939. R. H. Beamer, U. of K. 7 min.
17. Trends in Morphological Research. Kathleen Doering. U. of K. 7 min.
18. New Aquatic Hemiptera from the Orient. H. B. Hungerford. U. of K. 7 min.
19. Economic Importance of Bibionidae. D. Elmo Hardy. U. of K. 7 min.
20. The Halobatinae in the University of Kansas Collection. Eugene Kenaga. U. of K. 7 min.
21. The Gerrinae in the University of Kansas Collection. Louis Kuitert. U. of K. 7 min.
22. Leafhopper Populations Inhabiting Pastures in Kansas, (Family Cicadellidae). D. A. Wilbur, K. S. C. Read by title.
23. Some Insects Infesting Poisy Ivy. Dick Schwitzgebel, K. S. C. Lantern. 8 min.
24. Some Recent Observations on the Sugar Cane Root-stock Weevil *Anacentrinus deplanatus* Csy. H. R. Bryson, K. S. C. 10 min.
25. Grasshoppers in the Scott County State Park. Roy Fritz, K. S. C. 10 min.
26. A Fine Specimen of a Fossil Dragon Fly Wing from the Elmo Beds—*Megatyphus schucherti* Tillyard. F. M. Carpenter, Museum of Comparative Zoology, Cambridge, Mass.
27. Some Parasite Flies Reared from the Adults of *Phyllophaga lanceolata* Say. Harry R. Bryson, K. S. C. 8 min.
28. Recent Work on the Arthropod Transmission of Equine Encephalomyelitis at Kansas State College. A. W. Grundmann, K. S. C. 5 min.

FINAL BUSINESS:

REPORT OF THE RESOLUTIONS COMMITTEE:

WHEREAS, the University of Wichita, The Kansas Academy of Science, and the Local Committee in charge have all cooperated in making the 16th annual meeting of this Society a success,

BE IT RESOLVED, that the thanks and appreciation of the Society be extended to the University of Wichita, the Kansas Academy of Science, and to the members of the Local Committee especially for the arrangements for the noon luncheon.

WHEREAS, the reports of the Secretary-Treasurer and the Editor show the business of the Society and its Journal to be in excellent order,

BE IT RESOLVED, that the Society express its appreciation to H. H. Walkden and P. B. Lawson for their efforts in their respective offices.

(Signed) L. C. Woodruff, R. H. Painter, Chas. Curtiss.

REPORT OF THE NOMINATIONS COMMITTEE.

Mr. Wilbur reported for the committee, placing in nomination the following members for officers for the coming year:

For President: R. L. Parker.

For Vice-President: D. Isely.

For Secretary-Treasurer: H. H. Walkden.

He added that Mr. Beamer and himself wished to place Mr. Whelan in nomination for Vice-President but that Mr. Whelan objected inasmuch as he was a member of the committee. Mr. Bryson placed Mr. Whelan in nomination for Vice-President. Nominations were closed. Mr. Painter moved that the Secretary cast a unanimous ballot for the President and Secretary-Treasurer, and that the members elect a Vice-President by a show of hands. Motion seconded and passed. On a showing of hands, Mr. Whelan was elected Vice-President.

It was left to the Executive Committee to select the time and place for the next meeting.

There were 45 members and friends in attendance from Lawrence, Manhattan, Wichita, Dodge City, Emporia, Hays, Garden City, Newton, and Coffeyville in Kansas, and Lincoln, Nebr., and Kansas City, Mo.

Adjournment was at 4:45 P. M.

Respectfully submitted,

H. H. WALKDEN, Secretary-Treasurer

INDEX—VOLUME 13

JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY

	Page
<i>Achalarus lyciades</i> (Geyer), A Distributional Note on	114
<i>Alloeorrhynchus</i> (Hemiptera: Nabidae), New and Little-known Species of	115
<i>Amblyscirtes nysa</i> Edwards (Lepidoptera:Hesperiidae), Distribution Notes on	7
Annual Meeting, Notice of	3
<i>Argynnis cybele krautwurmi</i> Holland, A Note on	129
Beamer, R. H., Article by	51
Bot Flies, Notes on Oklahoma	44
Bruce, W. G., Articles by	41, 128
Butterflies, New Records of . . . for Kansas	28
Butterfly Records, Some Unusual . . . for Kansas	30
<i>Cochlorhinus Uhler</i> and Some Related Genera of Leafhoppers	51
<i>Contarinia juniperina</i> Felt, The Juniper Midge	46
<i>Copaodes aurantiaca</i> (Hewitson), Distributional Notes on	50
Dolichopodidae (Diptera), New Mid-Western	58

INDEX—VOLUME 13 (continued)

	Page
Dorylaidae Notes and Descriptions (Pipunculidae-Diptera) -----	101
Eddy, Gaines W., Article by -----	44
Emerson, Kary C., Article by -----	44
Enithares, A New . . . for Australia (Notonectidae-Hemiptera) -----	130
Field, William D., Articles by -----	23, 30
Field, William D., Notes by -----	7, 50, 57, 57, 114, 123, 129
Fritz, Roy F., Article by -----	86
Goodrich, Arthur L., Jr., Article by -----	33
Grais stigmaticus (Mabille), A Distribution Note on -----	57
Grasshopper Population of Typical Pastures in the Bluestem Region of Kansas -----	86
Hardy, D. Elmo, Articles by -----	15, 101
Harmston, F. C., Article by -----	58
Harris, Halbert M., Article by -----	115
Heterochroa bredowii (Geyer), A Distributional Note on -----	123
Horn Flies on Cattle, Intravenous Injections of Arsenic Ineffec- tive in Controlling -----	128
Horn Flies, The Medication of Cattle for the Control of -----	41
Hungerford, H. B., Articles by -----	8, 130
Insect Population Summary of Kansas, 1939 . . . The Ninth Annual -----	65
Kelly, E. G., Article by -----	65
Knowlton, G. F., Article by -----	58
Miller, H. D. Oliver, Article by -----	1
Minutes of the Sixteenth Annual Meeting -----	132
Mormon Cricket Injury to Forage, A Field Method for Estimating New Corixidae from China, Manchuria and Formosa -----	124
Parker, Ralph L., Article by -----	8
Phyllophaga from Jamaica, A New -----	46
Phyllophaga, Notes on Texas . . . with Description of One New Species -----	14
Plecia (Bibionidae-Diptera), Studies in New World -----	4
Reinhard, H. J., Article by -----	15
Sailer, R. I., Article by -----	4
Sanderson, Milton W., Article by -----	62
Skipper Record for the United States, A New -----	14
Smith, Roger C., Article by -----	57
Starling Attacks upon Warble Infested Cattle in the Great Plains Area -----	65
Stenoma mistrella Busck (Stenomidae, Lepidoptera), Observa- tions on -----	33
Swain, Ralph B., Article by -----	1
Telenomus ovivorus (Ashmead), an Egg-parasite of the False Chinch Bug -----	124
Thyreocorinae, A New Species of -----	6
Wadley, F. M., Article by -----	62
Wenger, Otto E., Article by -----	6
Wilbur, Donald A., Article by -----	46
	86

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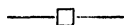
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CONTENTS OF THIS NUMBER

Dorylaidae Notes and Descriptions (Pipunculidae-Diptera) D. Elmo Hardy	101
A Distributional Note on <i>Achalarus lyciades</i> (Geyer) (Lepidoptera: Hesperidae) Wm. D. Field.....	114
New and Little-known Species of <i>Alloeorrhynchus</i> (Hemiptera: Nabidae). Halbert M. Harris	115
A Distributional Note on <i>Heterochroa bredowii</i> (Geyer). (Lepidoptera: Nymphalidae). Wm. D. Field	123
A Field Method for Estimating Mormon Cricket Injury to Forage. Ralph B. Swain	124
Intravenous Injections of Arsenic Ineffective in Controlling Horn Flies on Cattle. W. G. Bruce	128
A Note on <i>Argynnis cybele krautwurmi</i> Holland (Lepidoptera: Nymphalidae). Wm. D. Field	129
A New Enithares for Australia (Notonectidae-Hemiptera) H. B. Hungerford	130
Minutes of the Sixteenth Annual Meeting, Wichita	132
Index—Volume 13	135

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